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Bureau of Publications
Teachers College, Columbia University
New York City

Science Education

THE FIFTY "BEST" PUBLISHED INVESTIGATIONS IN THE TEACHING OF SCIENCE FOR THE YEARS 1931 TO 1937 INCLUSIVE

FRANCIS D. CURTIS
University of Michigan

STATEMENT OF THE PROBLEM

The purpose of this investigation was to determine the "best" or most significant published studies in the field of the teaching of science for the seven years from 1931 to 1937, inclusive.

METHOD

In the fall of 1937 a letter was sent to every member of the National Association for Research in Science Teaching, requesting him to return a list of bibliographical references of his own and other investigators' important research studies which had been published during the period from 1931 to 1936, inclusive. The resulting extensive list was supplemented with a much more extensive one assembled by twenty graduate students in the author's Seminar in the Teaching of Science. This composite bibliography, occupying nine single-spaced, mimeographed pages, was submitted to the members of the National Association for Research in Science Teaching with the following instructions for evaluation:

> Write "2" in the left-hand margin opposite each title which you think should certainly be included in a limited volume of research studies in this field.
>
> Write "1" opposite each title which you consider not in the first rank of investigations, but yet desirable for inclusion if space limitations permit.
>
> Write "—1" opposite each title which you consider scarcely worthy of inclusion in a limited list of investigations.
>
> Write "—2" opposite each title which for any reason you consider totally unworthy of inclusion in this list of investigations.
>
> Please evaluate only those studies with which you are familiar. It seems impossible for anybody to know all the studies sufficiently well to be able to evaluate them.

The evaluators were further requested to include references to other studies which had been overlooked in compiling the bibliography, and to add also bibliographical references to studies published during 1937, since it had been decided to expand the scope of the list to include that year. A total of 45 evaluated lists were returned.

A second bibliography was prepared to include the additional titles suggested by the forty-five respondents, and also those titles for the year 1937 included in a composite bibliography of published studies prepared by the members of the author's Seminar in the Teaching of Science. This bibliography occupying four single-spaced, mimeographed pages was, like the preceding one, submitted to the members of the National Association for Research in Science Teaching, with the request that they evaluate the studies in accordance with the same instructions as those used in evaluating the studies in the first one. Thirty members returned evaluated copies of this bibliography.

In determining the composite evaluations, the algebraic sums of points assigned the respective studies were computed for the entire list of titles in both bibliog-

raphies. In order to make the evaluations of studies on the second bibliography, of which thirty copies were returned, comparable with those on the first, of which forty-five were returned, the algebraic sums of the points assigned by the evaluators to the studies in the second list were each multiplied by 1.5. The evaluations of the studies on both lists thus made comparable, ranged from +64 to −18 points. The smallest number of respondents who evaluated any of the studies was two; the largest number, 34.

It is obvious, of course, that a plan of evaluation such as the one here used does not necessarily result in a list which includes only the best, or the most significant studies. A number of considerations may condition the separate evaluations of the individual studies. One evaluator may consider the most important factor to be the degree of refinement of experimental and statistical technique employed in the solution of the problem; another may hold that such considerations are of secondary importance when compared with the practical value of the study as indicated by the potential effects of its results upon existing practice; a third may base his judgment chiefly upon the scope or the extensiveness of the investigation; still another may be influenced in his judgment of the merits of the study by the extent to which it contributes to the solution of a problem in which he is, himself, most interested; another may be favorably impressed by a study because of the uniqueness of its problem; and so on.

The composite evaluations resulting from the pooling of a number of separate evaluations, such as those submitted for these studies, are conditioned by still other factors. One study may receive a much larger total number of points than another because more evaluators are familiar with it. An investigation of commanding merit may be practically unknown because it has been published in a magazine of restricted circulation or as a book of limited distribution; or because it has been published too recently to have achieved wide dissemination. On the other hand, a study published within the past year or so may receive more favorable evaluations because it remains more freshly in the memories of the evaluators, than other studies of equal merit published and widely read several years earlier.

It can therefore only be claimed for the bibliography that follows that it includes the published studies in the field of the teaching of science for the seven-year period from 1931 to 1938, which are most favorably considered by the group who are probably most competent to evaluate them. Also, it seems reasonable to assume that among the titles included there are many which will stand the test of time in meriting places among the best in the field, for the period represented.

One further statement seems appropriate before the list is presented: Various comments which accompanied the evaluations indicated that there were differences of opinion among the respondents with respect to what constitutes a research investigation in the field of the teaching of science. These protests centered about certain titles submitted by their authors or by other members of the National Association for Research in Science Teaching which in the judgments of their critics expressed "mere opinions," or reported "library research," or which described a study in a general way but did not include in its presentation any objective data in the light of which the investigator's conclusions might be validated. Such "borderline" studies, however, though often receiving favorable comments with respect to their merits as articles, received in every case a sufficient number of minus evaluations to eliminate them from this final list of research investigations.

The titles in the bibliography that follows are listed alphabetically by authors

but for reasons indicated in the preceding discussion the composite ratings by the evaluators are not stated.

BIBLIOGRAPHY

Arnold, Herbert J. *The Selection, Organization, and Evaluation of Localities Available for Unspecialized Field Work in Earth Science in the New York City Region.* New York: Bureau of Publications, Teachers College, Columbia University, 1936.

Arnspiger, V. C. *Measuring the Effectiveness of Sound Pictures as Teaching Aids.* New York: Bureau of Publications, Teachers College, Columbia University, 1933.

Bail, Philip N. "A Critical Analysis of Pupil Responses to Concepts of Mechanics in High School Physics," *Science Education,* XVII (October and December, 1933), 226–32 and 321–29.

Barnes, Cyrus W. "Criteria for the Selection of Science Teaching Materials," *Science Education,* XIX (December, 1935), 152–57.

Bedell, Ralph C. *The Relationship Between the Ability to Recall and the Ability to Infer in Specific Learning Situations.* Kirksville, Missouri: Northeast Missouri State Teachers College Bulletin No. 9, Vol. XXXIV, December, 1934.

Bray, Willis Joseph. *Achievement in General Chemistry as it is Related to Certain Learning Abilities.* Kirksville, Missouri: Northeast Missouri State Teachers College Bulletin No. 6, Vol. XXXI, July, 1931.

Caldwell, Otis W., and Lundeen, Gerhard E. *Studies of Unfounded Beliefs.* Units of this series of investigations are reported as follows: *Do You Believe It?* New York: Doubleday, Doran and Company, Chapter IX; *An Experimental Study of Superstitions and Other Unfounded Beliefs as Related to Certain Units of General Science* (New York: Bureau of Publications, Teachers College, Columbia University, 1932); "Changing Unfounded Beliefs—A Unit in Biology," *School Science and Mathematics,* XXXIII (April, 1933), 396–413; and "Students' Attitudes Regarding Unfounded Beliefs," *Science Education,* XV (May, 1931), 246–62.

Caldwell, Otis W., and Weller, Florence. "High School Biology Content as Judged by Thirty College Biologists," *School Science and Mathematics,* XXXII (April, 1932), 411–424.

Carpenter, Harry A. "Results of a Three-Year Science Sequence in Junior High School Grades," *Science Education,* XVII (October, 1933), 183–92.

Carter, W. R. "A Study of Certain Mathematical Abilities in High School Physics." This study is published complete in the *Mathematics Teacher,* XXV (October, November, and December, 1932), 313–31, 388–419, and 451–69, and is distributed by the investigator, School of Education, University of Missouri.

Clem, Orlie M., and Dudelston, Joseph J. "Factors Influencing the Common Science Knowledge of High-School Pupils," *Science Education,* XVII (December, 1933), 267–72.

Clemenson, Jessie Williams. *Study Outlines in Physics, Construction and Experimental Evaluation.* New York: Bureau of Publications, Teachers College, Columbia University, 1933.

Crowell, Victor L. "Attitudes and Skills Essential to the Scientific Method, and their Treatment in General-Science and Elementary-Biology Textbooks," *School Science and Mathematics,* XXXVII (May, 1937), 525–31.

Croxton, W. C. "Pupils' Ability to Generalize," *School Science and Mathematics,* XXXVI (June, 1936), 627–634.

Cunningham, Harry A. "Curriculum Analysis as a Basis for Determining Science Rooms, Service, and Furnishings in Teachers Colleges," *Science Education,* XX (October, 1936), 151–56.

Curtis, Francis D. "The Teaching of Science in Secondary Schools of the North Central Association," *North Central Association Quarterly,* VI (March, 1932), 433–74.

Curtis, Francis D., and Darling, Wesley C. "Teaching Values of Common Practices in Correcting Examination Papers—a Second Study," *School Review,* XL (September, 1932), 515–25.

Davis, Ira C. "The Measurement of Scientific Attitudes," *Science Education,* XIX (October, 1935), 117–22.

Downing, Elliot R. *Investigations of Scientific Thinking.* The first unit is reported under the title, "Does Science Teach Scientific Thinking," in *Science Education,* XVII (April, 1933), 87–97; the second appears as "Some Results of a Test on Scientific Thinking," in *Science Education,* XX (October, 1936), 121–128.

Downing, Elliot R. "Teaching Units in Biology, An Investigation," *North Central Association Quarterly,* V (March, 1931, 453–57.

Duel, Henry Ward. "Measurable Outcomes of Laboratory Work in Science: A Review of Experimental Investigations," *School Science and Mathematics,* XXXVII (October, 1937), 795–810.

Efron, Alexander. *The Teaching of Physical Sciences in the Secondary Schools of the United States, France, and Soviet Russia.* New York: Bureau of Publications, Teachers College, Columbia University, 1937.

Fitzpatrick, Frederick Linder. *Science Interests.* New York: Bureau of Publications, Teachers College, Columbia University, 1936.

Frutchey, F. P. "Retention in High School Chemistry," *Ohio Educational Research Bulletin* (Columbus, Ohio: Ohio State University), XVI (February 17, 1937), 34–37.

Gemmill, Anna M. *An Experimental Study at New York State Teachers College at Buffalo to Determine a Science Program for the Education of Elementary Classroom Teachers.*

New York: Bureau of Publications, Teachers College, Columbia University, 1937.

Gillson, Margery Stewart. *Developing a High School Chemistry Course Adapted to the Differentiated Needs of Boys and Girls.* New York: Bureau of Publications, Teachers College, Columbia University, 1937.

Hall, W. J. "A Study of Three Methods of Teaching Science with Classroom Films," *School Science and Mathematics,* XXXVI, (December, 1936), 968–72.

Hartman, George W., and Stephens, Dean T. "The Optimal Teaching Sequence for Elementary Physical Principles Based on a Composite Scale of Pleasure-Value and Difficulty of Insight," *Journal of Educational Psychology,* XXVIII (September, 1937), 414–36.

Haupt, George W. *An Experimental Application of a Philosophy of Science Teaching in an Elementary School.* New York: Bureau of Publications, Teachers College, Columbia University, 1935.

Havighurst, Robert J. "Survey Courses in the Natural Sciences," *The American Physics Teacher,* III (September, 1935), 97–101.

Heiss, Elwood D. *An Investigation of Content and Mastery of High School General Science Courses.* Published by the investigator and may be obtained from him at State Teachers College, East Stroudsburg, Pennsylvania.

Holy, T. C., and Sutton, D. H. *List of Essential Apparatus for Use in High-School Science.* Bureau of Educational Research Monographs, No. 12. Columbus, Ohio: Ohio State University, 1931.

Hunter, George W. *A Study of the Objectives and the Sequence of Courses of Science in the Junior and Senior High School.* This study is the third of a series, the preceding numbers of which were published in 1910 and 1924. Units of this study are reported as follows: "The Sequence of Science in the Junior and Senior High Schools," in *Science Education,* XVI (December, 1931), 103–15; "Science Sequence in the Junior and Senior High Schools," in *School Science and Mathematics,* XXXIII (February, 1933), 214–23); and (in collaboration with Roy Knapp), "Science Objectives at the Junior- and Senior-High-School Levels," in *Science Education,* XVI (October, 1932), 407–16.

Hurd, Archer Willis. "How Shall Science Instruction Be Organized?" *Science Education,* XVIII (April, 1934), 106–11.

Hurd, Archer Willis. *Co-operative Experimentation in Materials and Methods in Secondary-School Physics.* New York: Bureau of Publications, Teachers College, Columbia University, 1933.

Johnson, Palmer O. "Concomitant Learning in Human Biology," *Science Education,* XX (February, 1936), 11–17.

Johnson, Palmer O. "The Measurement of Outcomes of Instruction Other than Information," *School Science and Mathematics,* XXXIV (January, 1934), 26–33.

Maller, J. B., and Lundeen, G. E. "Sources of Superstitious Beliefs," *Journal of Educational Research,* XXVI (January, 1933), 321–43.

Newland, Eveus. "A Study of Allusions to Science in Magazines," *Science Education,* XXI (October, 1937), 126–30.

Noll, Victor H. "Measuring the Scientific Attitude," *Journal of Abnormal and Social Psychology,* XXX (July–September, 1935), 145–54.

Pruitt, Clarence Martin. *An Analysis, Evaluation, Synthesis of Subject-Matter Concepts and Generalizations in Chemistry.* Published by the investigator, 1935, and distributed through *Science Education.*

Pruitt, Clarence M. "Survey Courses in the Natural Sciences," *Science Education,* XXI (February, 1937), 10–16.

Rice, R. S. "Extensive Reading *Versus* Intensive Reading Textbook Study as a Means of Acquiring a Knowledge of Scientific Facts," *Journal of Experimental Education,* IV (June, 1936), 376–402.

Robertson, Martin L. "The Selection of Science Principles Suitable as Goals of Instruction in Elementary Science," *Science Education,* XIX (February and April, 1935), 1–4, 65–70.

Robertson, Martin L., and Barnard, J. Darrell. "A Comparison of the Relative Effectiveness of Two Methods of Teaching General Science," *Science Education,* XX (December, 1936), 200–06.

Rulon, Philip J. *The Sound Motion Picture in Science Teaching.* Cambridge, Massachusetts: Harvard University Press, 1933.

Tyler, Ralph W. "Permanence of Learning," *Journal of Higher Education,* IV (April, 1933), 203–04.

Weller, Florence. "Attitudes and Skills in Elementary Science," *Science Education,* XVII (April, 1933), 90–97.

Winokur, Morris. "A Survey of Generalized Science Courses in Institutions of Higher Education," *Science Education,* XX (October, 1936), 132–40.

Wrightstone, J. Wayne. "Correlation of Natural Science Beliefs and Attitudes with Social and Intellectual Factors," *Science Education,* XVIII (February, 1934), 10–12.

PRELIMINARY REPORT OF THE COMMITTEE OF THE NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING ON THE TRAINING OF SCIENCE TEACHERS

The committee of the N. A. R. S. T. on the training of science teachers is one of several committees appointed to carry on investigations for the association. The present report is a revision of reports previously organized, submitted, criticized, and approved at meetings of the association at St. Louis in 1936 and at New Orleans in 1937.

The committee has attempted first to bring together statements of the predominant issues concerning the training of science teachers. It is now engaged in an attempt to produce a positive statement of a desirable program for training science teachers.

Practically all of the work of the committee has been carried on by correspondence. The difficulties and the time consumed in working under such conditions are obvious.

The statements of the issues were originally gathered from members of the committee. These were mimeographed and submitted to members of the association at one of the annual meetings. After criticisms and discussion, the statements of issues were submitted again to the committee.

An attempt has been made to produce a resolution of the issues in terms of the available literature on the subject. The bibliography is not exhaustive, but sufficiently representative that the addition of a few other references would not change the nature of the report materially.

The names of the members of the committee writing the resolving statements occur in parentheses following the statements of the issues. The statements do not necessarily express the personal points of view of the individuals writing them.

Each statement has been submitted several times to the whole committee. The whole report has been presented to the association in two open meetings.

Mr. Jean participated in the original gathering of the issues, but was unable to take part in the writing of the report when it was in process of construction. He has since returned to the committee. Mr. Cahoon was appointed to membership on the committee after the original report was formulated.

ISSUES CONCERNING THE PREPARATION OF SCIENCE TEACHERS IN ELEMENTARY AND SECONDARY SCHOOLS

Prepared by the Committee on the Training of Science Teachers of the National Association for Research in Science Teaching

Issue No. 1: (Cunningham)

Are "science teachers" to be trained for work in elementary schools, or are all elementary school teachers, as general practitioners, to be trained to teach elementary science?

Every elementary teacher should be given sufficient training in science to enable her to teach this subject as effectively as she now teaches history, geography, or arithmetic.

In schools of sufficient size and with adequate financial support a science specialist may be very desirable. Such a specialist may be of great assistance in helping to work out the science program in the course of study. Until the regular classroom teacher is better prepared to teach science, the specialist may be of great help and may, in the presence of the regular teacher, even teach certain demonstration lessons.

The teaching of all science in the grades by specialists is neither desirable nor practicable.

Supporting facts and opinions of experts:

In many elementary schools of the country the regular classroom teachers must teach the science, if it is taught at all, because science special-

ists in addition to the regular teacher cannot be afforded. (12:154)

"The experience of many specialists has been that, to be really effective, departmental instruction must take place as many as three or four times a week." (12:156)

The failure of science to take its rightful place in the elementary school program "has been partially due to the idea prevalent in many places that science teaching must depend upon the employment of specialists." (51:154)

The regular classroom teacher is the one most able to coordinate the learning in science with the classroom activities, in a way in which the science specialist "who comes into the classroom only at stated periods" cannot do. (12:155)

It is not necessary for a successful teacher of elementary science to differ in character and personality from the ordinary successful elementary teacher. (12:155)

No elementary teacher can know beforehand all the answers to all the questions about science that the pupils will ask, but the regular teacher can be a student with her pupils. (51:289)

"There is a lack of interest in science among teachers and school authorities. Science is still conceived of as a subject for specialists, as a subject of instruction for secondary school and college." (51:283)

Issue No. 2: (Haupt)

> Are science courses for the training of elementary school teachers to be generalized, or survey type courses, or special courses selected from the various specialized fields in natural science?

The success of the professionalized subject matter courses, field courses, and the more specialized science courses, depends to a great extent upon the background and perspective which the students have obtained in the orientation course. (20)

The main objectives of an orientation course are drafted with the assumption that there is an ever present need for effective adjustment of an individual to a constantly changing condition of life. (20)

There must be an attainment of understanding of those generalizations and principles of science which constantly apply to human experience in their physical, social, and mental aspects. (20)

There must be understanding and intelligent interpretation of natural phenomena which arise in life's experiences. (20)

The orientation course gives a fundamental setting and perspective for the presentation of the content materials which are given in succeeding years.

(See also references No. 26:91–101, 31, 39, 48:253–255, 70, 52:331–332.)

Issue No. 3: (Watkins, Robertson, and Haupt)

> Can elementary school teachers get adequate training in the subject matter of the natural sciences through "professionalized subject matter" courses, or must they be trained in science through courses dealing more specifically with details of science subject matter as such?

This depends primarily upon the resolution of Issue No. 10. If professionalized science courses are defined merely as *science courses* selected specifically for the training of teachers, then this question resolves itself into the question of the extent of the training to be offered. See also definition (2) under "Issue No. 10."

If professionalized subject matter courses are merely reviews of elementary science or high school science courses, such courses are inadequate for the training of elementary school teachers in science.

To date, too few teachers have been trained through professionalized subject-matter courses to give a very definite basis of comparison with teachers trained otherwise.

It is probable that workers within the science fields themselves will look askance at a program for the training of elementary school teachers in science through professionalized subject-matter courses only.

The best training that could be offered by teacher training institutions for elementary school teachers in science at present would consist of a combination of professionalized science courses and some well selected courses in the special sciences.

(See references No. 9, 29, 32, 33, 38, 54.)

Issue No. 4: (Cunningham)

> Under existing organizations, are elementary school teachers best trained for science teaching in schools of education of universities, and departments of standard colleges, or in specifically organized teachers' colleges?

No one kind of institution that is now engaged in the training of teachers can be said to be best for the training of elementary science teachers. Prospective elementary science teachers should, however, receive training in science in courses designed to train teachers in science. Possibly there may be an exception to this rule in the case of the most advanced courses in science given prospective teachers.

Supporting facts and opinions of experts:

The opinions of individuals engaged in teacher training indicate that the training of teachers should take place in institutions where the courses given to prospective teachers are professionalized. (34:277–280) (66:154)

There is "need for specific and exclusive institutions, or at least for specific and exclusive classes, for the training of teachers" in science. (34:279)

At present, no one type of institution engaged in the training of teachers in science may be considered best for this purpose. Liberal arts colleges are deficient in professional interest and spirit and teachers colleges are deficient in the "breadth of training and contacts." The liberal arts colleges and the teachers colleges, "so far

as the education of four-year high school teachers is concerned, are moving toward each other rapidly." (45:381–391) (66:154–164)

Studies indicate that "relatively little has been accomplished toward professionalizing subject-matter sources in science. Almost all of the professionalization has been done in teachers colleges and normal schools. It has been most successful in the latter because they prepare elementary school teachers." (34:278)

Unpublished data from a study of the "Rooms, Service, Furnishings, Equipment, and Supplies Used in the Training of Intermediate Grade Teachers in Science" by seventeen outstanding teachers colleges together with a study of the courses given in the training of such teachers in science in these same institutions indicate that there is a lack of uniformity in the material facilities used, that there must be lack of correlation between the courses given the prospective teachers and the science material which these teachers must later teach, as indicated by a curriculum study of some of the outstanding courses of study in science for these same grades. The training in physical science is very deficient for these prospective teachers in these teachers colleges. While over 2,000 different items of equipment and supplies are used by these teachers colleges in the training of intermediate grade teachers in science, there is considerable lack of agreement among them as to the material facilities used, and the items used by at least three-fourths of these institutions are for the most part suitable only for use in the teaching of biological science. There is marked lack of correlation between these material facilities used in the teachers colleges and the equipment and supplies used in the teaching of intermediate grade science in some of the best grade schools of the country, and there is also some lack of correlation between the material facilities indicated as necessary as a result of a curriculum analysis of some of the best courses of study in science for the intermediate grades. (13)

Issue No. 5: (Haupt)

Is a distinction to be made in the training of science teachers for junior high schools, senior high schools, and four year high schools, or is it to be assumed that the same type of training fits a teacher for work in any of these types of secondary schools?

No clear cut distinction in the functions of these three types of high schools is made in practice. Teachers transfer, or are "promoted," from one to the other without changes or distinctions in training for the possible different types of services to be rendered.

Minimum state and city standards of training for all science teachers in all types of secondary schools are in general exceedingly low. In most cases no distinction is made for differences in types of high schools in setting state and city standards of training in the sciences.

Until there is a clearly defined field for professional service for science teachers in the different types of secondary schools, it is not practically feasible to set up different standards of training for science teachers in junior high schools, senior high schools, and four year high schools.

Most schools now require both junior and senior high school teachers to have a bachelor's degree. (56)

The minimum professional training (for high school teaching) of any academic subject shall be fifteen hours in education. (56)

For high school science teaching, fifteen hours of science work is required, five of which must be in the science taught. (56)

In the curricula usually offered for preparation to teach a specific field of science not enough study is given to the other sciences.

(Also see references No. 31, 52:333–335, 8, 43, 65.)

Issue No. 6: (Watkins and Haupt)

Is the beginning training of the high school science teacher to consist of generalized or survey type science courses, or of beginning courses selected from the special fields of science?

There is a growing opinion that the typical specialized science course, intended primarily for the training of science specialists or college teachers in a single field, is not the best type of course for the prospective high school science teacher.

Teachers of junior high school courses and teachers of courses in general science and general biology need a more extensive training than most of those teachers now have.

The majority of high school science teachers need thorough training in science as a field rather than intensive training in a single specialized science.

The extension of the general training of high school science teachers may be attained in two ways:

(1) By inducting the student into science through a basic training in the first two years of college work in generalized or survey type science courses (possibly professionalized subject matter courses). This generalized training to be followed by special science courses selected to meet the student's specific training needs.

(2) By extending the range and the quantity of training by the inclusion of both a greater number and a greater variety of special science courses in the student's training program.

There is little specific evidence to date which indicates clearly which of these is the better training program for high school science teachers.

Issue No. 7: (Watkins)

Are high school teachers to be trained to teach the whole program of sciences to be taught in a high school, or are they to be trained to teach a major, or a major and a

minor, science subject with highly specialized training in a limited field?

Under present conditions science teachers should be trained to teach the whole pattern of sciences most frequently offered in the high schools. This pattern at present includes general science, general biology, physics, and chemistry.

The undergraduate training of the prospective science teacher should include enough training in one of the fields of science to insure that the teacher is well grounded in that one field, and to enable the teacher to continue graduate training in the field of his choice in a graduate department of a recognized university.

To accomplish the type of training indicated here requires approximately half the number of college semester hours included in the undergraduate training of the prospective high school science teacher.

Understanding one science requires some understanding of related sciences and of science as a whole.

Supporting facts:

The majority of high school science teachers now teaching in high schools teach combinations of subjects.
(14, 30: 509–511, 37, 42, 47, 63, 74, 77)

The majority of teachers teaching sciences teach combinations of sciences. (Ibid.)

Predominant patterns of sciences taught in high schools are not single specialized sciences.
(14, 30: 116–120, 52: 244–245, 74)

The most frequently offered sciences at present in high schools are generalized sciences, general science, and general biology. (14, 30: 33–51, 53)

Beginning teachers and teachers in smaller high schools must be able to teach combinations of science. (14, 30, 37, 42, 63, 74, 77)

Experienced teachers in city school systems often teach combinations of science subjects. (14)

Graduate schools of major universities are organized into special science departments. A student must have had an undergraduate major in such a department to begin work as a graduate student in the department. (52: 335)

(See also reference No. 40 and the catalogs or announcements of any of the major universities.)

Issue No. 8: (Watkins)

Are high school teachers to be permitted to teach generalized science courses, *e.g.*, general science and general biology, with a minimum of science training, or are all high school science teachers to be trained as fully as possible in the sciences which they teach?

The bare minima set up by many state departments of education, and by some city systems, as requirements for high school teachers of general science and general biology should be discarded in favor of requirements for a breadth of training which will enable teachers to teach such courses in terms of the currently accepted objectives.

The college trained subject-matter specialist with the majority of his training in one field of science, is not in most cases a satisfactory teacher of generalized secondary school courses.

The recommendations indicated under "Issue No. 7" above would enable teachers to meet this situation adequately under present conditions.

There remains the question of the relative usefulness of the typical college course in a special science as contrasted with survey courses, field courses, and professionalized subject-matter courses for the training of teachers of generalized secondary school courses in science. (See Issues 6, 10, 12, and 18.)

Supporting facts:

Analyses of the content of existing general science and general biology courses indicate the range of training needed to teach such courses.
(15, 18, 21, 30, 46, 58, 59)

Many teachers now employed to teach general science and general biology have inadequate training for such work.
(14, 21, 30: 511–513, 37, 43, 55)

Minimum requirements for teachers of general science and general biology set up by the majority of state departments of education, and by some city systems, are entirely inadequate as compared with the range of content of textbooks, and courses of study in these high school courses. (62)

Unit No. 9: (Watkins)

Are secondary school science teachers to be trained in subject matter in such a way that they can continue training on a graduate level in the science departments of graduate schools in universities, or is the under-graduate training of science teachers to be set up without regard to possible continuance of training in science in graduate schools?

Science teachers for secondary schools should be trained so that they are equipped to teach the program of science commonly offered in the high schools. (See Issues Nos. 7 and 8.)

At the same time these teachers should have enough training in some one field of special science to maintain the respect of scientists and to be able to continue graduate work in such a field in one of the major universities.

If approximately half of the undergraduate work of the prospective science teacher is done in the sciences both of these training objectives can be accomplished.

Supporting facts:

To maintain the proper coordination between the secondary schools and the colleges, science teachers in high schools must have a type of training which will enable them to have the respect of college workers in science. This means enough training in one science to meet the standards for a minimum undergraduate major in such a field. No objective evidence on this point has come into the hands of the committee.

The fact is a matter easily verified in the experience of almost any one of the group concerned with the training of science teachers for the high school.

There is a fairly definite trend toward a standard of five years of training for high school teachers. One state now requires this standard. A fairly large percentage of high school teachers in city systems have attained this standard or higher, whether or not it is required by the school authorities of their respective city systems.
(14, 62, 40) (See also Issue No. 11.)

In order to be able to carry on graduate work in science it is necessary for the student to have had a minimum undergraduate major in some one of the special sciences. This minimum major usually amounts to approximately 24 semester hours of college work.

This statement can be verified easily by references to the catalogs or announcements of the Graduate Schools of the Universities belonging to the Association of American Universities.

Issue No. 10: (Haupt and Robertson)

What are professionalized subject-matter courses? How effective are these in the training of science teachers?

There are two acceptable definitions of professionalized courses.

(1) A course in which a review of the subject-matter and principles of the high school course is made the basis for practical exercises in conducting demonstrations and laboratory work, in directing study, drill, review, projects and in other techniques in instruction.

(2) A course which is "first of all *subject matter*—accurate, scholarly, and of a degree of difficulty to challenge students at the level the course is offered, comparable in most of its content to the content of similar courses offered to students other than prospective teachers in colleges and universities. It is in no sense a review of material included in elementary or secondary school courses.

"In the second place, it is taught by an instructor who has a scholarly command of his field and, in addition to scholarship, has received, either by experience or extended observation of teaching in public schools and in the practice and demonstration school, a sensitiveness to the problems of teaching his subject to children of different ages and varied interests. He should know enough about the history and philosophy of education, educational psychology, tests and measurements in his subject, and similar professional material to be able to apply that information in his questions, in his illustrative comments, in his special assignments, in his demonstration lesson, in his examinations, in his supervision of practice teachers—in other words, in his teaching. This professional "flavoring" need take but a relatively small proportion of the total time of the course.

"In the third place, it is subject matter selected, whenever opportunities for selection exist, because the unit chosen will have more direct or indirect effect upon the work of the prospective teachers taking the course than other units which might be selected. This selection cannot be made except by instructors whose knowledge of the subject is sufficiently thorough to supply material from which to choose and who at the same time know the work of the public schools well enough to supply the criteria for these choices.

"In the fourth place, it is subject matter selected for teachers who should be leaders in their communities, who should realize the important role the schools will be called upon to play in molding citizens for a complex and changing civilization, who should be made conscious of the part the subject matter of the course can take in that molding, and who should develop personal interests which will contribute to their intellectual, social, and recreational life as individuals. The subject matter of the course should contribute whenever possible, to some or all of these ends." (1)

It is generally agreed by high school teachers and professors in schools of education that professionalized subject matter courses are valuable in the training of teachers. It must be remembered, however, that the final solution of all problems of the nature of this issue rests upon the development of an adequate technique for measuring teaching success.

Supporting facts:

For all institutions which were studied, colleges, universities, and teachers colleges, the rank order for subject matter fields which have been professionalized is biology, nature study, chemistry, physics, general science, and elementary science. (9)

For colleges and universities the average percentage for science courses which have been professionalized is 00.9 course per institution. (9)

For teachers colleges the average percentage for science courses which have been professionalized is 3.2 courses per institution. (9)

For state normal schools the average percentage for science courses which have been professionalized is 2.4 courses per institution. (9)

Professionalized subject matter is subject matter specifically defined for future teachers. (9)

The colleges and universities which train the greater portion of our teachers have done very little toward "professionalizing" their subject matter courses in science. (9)
(Also 1, 7, 16, 19, 29, 31, 32, 33, 34, 35, 38, 45, 54, 57, 73.)

Issue No. 11: (Robertson)

Is there a definite need for a five-year training program for science teachers or should teacher-training institutions concentrate upon the improvement of the four-year program?

It is the opinion of educators and administrators that the period of training for secondary school teachers should be lengthened to a minimum attainment of the master's degree.

The present emphasis upon general education as preliminary to specialization and professionalization of training has tended to shorten the time available for specific preparation for a position. The general raising of standards by certificating agencies and examining boards is increasing the pressure to extend the period of training. The practice of many school systems and several states of requiring a master's degree, or of giving preference to applicants possessing five years of training, is a powerful factor in forcing extended training.

On the other hand some states require successful experience for permanent certification and many systems require "alertness" in in-service education as a prerequisite to eligibility for salary increment. Too, no reliable comparative studies have been performed which indicate the relative effectiveness of various types of four-year programs, five-year programs, and "in-service" programs.

Success is measured in terms of salary gains and principals' rating cards, neither of which is an adequate instrument for this purpose.

If the period of training should be conditioned by the ability and willingness of communities to pay for the product, it is interesting to note that in 1934–35 one in every three teachers received less than $750 per year—equivalent to the minimum set by the "blanket code" for factory workers. The average salary of science teachers is higher than that of all teachers, however.

(2, 3, 4, 6, 10, 14, 27, 38, 62, 64, 65, 68, 69, 72)

Issue No. 12: (Robertson)

Are field courses and other courses dealing with objective materials for teacher training more or less effective than traditional science courses for the training of teachers? (See Issue No. 10.)

This issue requires careful definition with respect to what is included in field courses in science *for teachers* that is not included in traditional field courses in science. There is evidence indicating that field courses, museum study, sound and silent films, charts and models, gardening, camp instruction, and other activities involving the handling of objective materials do make a valuable contribution to the total experience of the learner. There is a tendency in teacher training institutions to offer single field courses involving important phases of botany, geology, and zoölogy. Other field courses are offered involving the applications of science in modern life. For many years, professionalized science field courses have been offered for elementary science teachers. Many educators and students feel that these latter mentioned types of courses are more adequate and functional than traditional types.

This issue, however, like "Issue No. 10," needs to be carefully studied with more precise instruments. (5, 44, 67)

See catalogs of Teachers Colleges and Schools of Education and Issues 10 and 13.

Issue No. 13: (Cunningham)

What influences do the equipment for field work and other objective means of adding to the experiences of prospective teachers have on the training in teacher training institutions?

Fundamentally, the study of science is becoming acquainted with various objects (larger or smaller aggregates of fundamental elements) in nature, groups of objects in nature, and interactions between two or more objects to the end that, after language symbols have been attached to the various objects, groups of objects, and the interactions between them; they may be experienced later, even in their absence, by means of language. This rapid vicarious experiencing of objects and interactions by means of language is of utmost importance in intelligent solution of problems.

In so far as the training of prospective teachers in science is concerned, the direct experience with objects and their interactions serves not only to enable them to acquire language symbols that have meaning, but it also gives them training in doing the activities that they will have to either perform or direct later in their teaching.

Material facilities used during the training of prospective teachers in science also serve as dominant factors in the varied and complex environment of these students and thus help to control the interest of the students and their reactions during their training in science.

Supporting facts and opinions of experts:

All material facilities used in the training of teachers must contribute directly to the attainment to objectives that are considered valid. (23:281)

Behavior is always a reaction to very complex environmental situations, one, or a few elements of which may be said to be dominant at any one time. Material facilities in the environment of pupils help to control their interest and therefore their relations to the total situation. (22:352–520)

"Equipment for science laboratories in elementary schools and in junior and senior high schools must be justified by the use that is to be made of it." (13)

We learn to respond to situations in a given way by being stimulated by various methods to respond in that way for a time sufficient in length for our body structure to undergo the necessary changes which enable it to respond in the desired way "when subjected only to the initial stimulation." Objects and interactions experienced in the laboratory or field should be identical or as nearly as possible like the elements of more complex reactions to life situations. (22:186) (28:70) (11:33, 72) (22:611–620) (60:66, 75)

A very important use of material facilities in education is to give language symbols meaning so that in our solution of problems we may perform most of our trial and error activities in

the field of language to the end that our first actual, or overt trial will be more likely to be successful. (22:133–163) (17:46, 51, 94) (76:307–327) (See also 50.)

Issue No. 14: (Cunningham)

To what extent shall science teachers be trained in science alone, and to what extent shall science teachers be trained to consider human uses and interpretations of science teachings?

If science teachers are to give the training that will be most effective in preserving and making for most efficient operation of our democratic form of government, it follows that our future citizens now in training in our schools must have training in the problem-solving ability. Science teachers then, must not only be thoroughly taught science facts and principles but they must also be taught the relationship of these facts and principles as important factors in the solution of our many complex individual and social problems. Most of our individual and social problems are so complicated that they cannot be entirely solved by the application of facts and principles of science but such facts and principles are often dominant factors in their solution.

The value of a science principle in general education may be said to be directly proportional to number of times it appears as a common element in solution of individual and social problems. The value of a science fact may be said to be in direct proportion to its contribution to the understanding of science principles. Prospective teachers of science must be able to teach the basic situations that are significant to pupils of a particular level, and the life situations in conconnection with which these same basic principles and facts are used. This acquaintance with adult problems makes them better able to select the facts and principles that are most significant for teaching.

Supporting facts and opinions of experts:

The point of view that is universally expressed in connection with any discussion of professionalized courses is that such courses should emphasize "consumer or functional science" and should emphasize "the practical applications, social and economic aspects, and the historical background."

(34:279) (61:27–40) (75:804–810)

Scientists are quite generally agreed that a general problem solving faculty or ability, the existence of which would make just any kind of problem solving in science work appropriate, does not exist; but that the facts and principles taught in science must be those that are involved as important elements in many different problematic situations in actual living.

(61:66) (75:804–810) (24:309–316)

Situations and the facts and principles of science which are important factors in their solution should be connected in the minds of the learners. (61:66) (75:804–810)

"Progressive thought is critical of knowledge as an outcome of education unless that knowledge is functional." (71:695–699)

Issue No. 15: (Watkins)

(a) Should the science department of the teacher-training institution supervise the practice teaching in the sciences, or should such supervision be done by the education department?

(b) Should courses in the methods of teaching the sciences in the teacher-training institutions be taught by instructors of the science departments, or should these courses be taught by instructors in the education department?

The supervision of practice teaching in the sciences in a teacher-training institution should be done by a member of the staff of the department of education rather than by an instructor from a science department.

It is possible that what is now known as practice teaching, or student teaching, may be done in the future in a fifth year of training as an apprenticeship or interneship in an established high school outside the teacher-training institution. In such case the supervision will need to be developed cooperatively between the education department of the teacher-training institution and the teaching staff of the high school in which the interneship is carried out. (See Issue No. 18.)

Courses in methods of teaching the sciences in a teacher-training institution should be taught by instructors in the education department, not by instructors from the science departments.

If one person can direct the supervision of practice teaching in the sciences and teach the courses in the teaching of science, it is highly desirable that the same individual do both.

The instructor in the department of education in immediate charge of practice teaching in science, or the teacher of courses in the teaching of science, should have at least as much training in the subject matter of science as the college students in his charge are expected to have. It is desirable that he be more highly trained in science.

The instructor in immediate charge of practice teaching in science, or the teacher of courses in the teaching of science, may well be a member of both the department of education and a science department of the teacher-training institution.

Supporting facts:

The education department of a teacher-training institution is charged directly and specifically with the professional training of the prospective teachers in the institution. This professional training includes practice teaching and courses in special methods. The science departments are charged directly with training the prospective teachers in the subject matter which they are to teach.

Members of science departments are usually interested primarily in the subject matter developed within the department. Courses for the training of high school teachers offered by such departments are often neglected because of this emphasis of interest in the departments.

Teachers whose major concerns are in a subject matter department tend to become absorbed by departmental interests and cease to be interested in professional courses for the training of prospective teachers.

Teachers of the subject matter departments of a teacher-training institution often do not see the problem of secondary education as a whole; they see only the needs for training in the field of the one department. Teachers trained and working in the department of education are more often aware of the needs of the secondary school as a whole.

Definite objective data dealing with this issue are practically non-existent. This issue presents a good field for experimentation and investigation. (23, 41, 49)

Issue No. 16:

Shall the four years of the teachers college be so arranged that the first two years are devoted to generalization and the last two to specialization, or shall specialization be carried through the whole four years?

There is no very satisfactory evidence on either side of this issue.

Materials previously quoted under issues Nos. 2, 6, 9, and 14 have some bearing on this issue.

This is an issue that concerns the whole of higher education, not just the college training of science teachers.

Trends in higher education in general would seem to indicate the generalization of training at the junior college level, and the delay of specialization until the latter two years of the four-year college.

Issue No. 17:

Should most of the field work in science be integrated with the content courses in sciences as usually given in the colleges, or should the field training of science teachers be given in separate courses?

Evidence on this issue is almost entirely lacking. But, see issues 10, 18, and 13, and appended bibliographies.

Some institutions are now offering special field courses for teachers, separated from the ordinary content courses in science. How much of such work could be done in the regular science courses would seem to depend upon the organization of the science departments and the points-of-view of the instructors in these departments.

Some special field courses are offered in connection with summer camps, park services, travel bureaus, and similar agencies. It is difficult to integrate this kind of field work with the usual content of classroom courses in science.

A few institutions are offering field work that seems successfully integrated with content courses. These courses are not necessarily intended primarily for teachers. Work in geology, botany, and zoölogy in some institutions offer good illustrations of possibilities.

Some courses in engineering colleges offer programs of integrated content and field work that seem successful for the training of engineers.

Issue No. 18:

Should practice teaching be offered in a fifth year as an apprenticeship in teaching, or in the fourth year of the college course of the prospective teacher?

Perhaps the only possible response to this is that no one knows. A third possibility might be to do both.

Material and bibliographies submitted above for issues Nos. 5, 9, and 11 have a bearing on this issue also, especially that suggested under No. 11.

There is some considerable movement in the direction of a five year program for the training of secondary school teachers. This is especially true for teachers for city school systems. Such a five year program would make possible the inclusion of the practice, or apprentice, training in the fifth year rather than in the fourth year.

There is no accepted pattern governing the fifth year of work. There are difficulties in some institutions in including practice teaching in the fifth year if it is to receive credit as a part of a graduate program accepted as part of the work for an advanced degree.

It is possible that a fifth year of work might consist of a year of work in the field as an apprentice, or an interne, as is now the common practice in the training of physicians and surgeons as internes in hospitals.

It would seem that institutions wishing to attempt the type of teacher training implied in the statement of this issue will have to experiment quite frankly with the types of administrative organization best adapted to local situations. The determination of the better kinds of organizations for the purpose of training teachers depend in large measure upon the development of satisfactory means of evaluation of systems of teacher training.

Bibliography

1. American Association of Teachers Colleges. "Findings of the National Survey of the Education of Teachers." *Twelfth Yearbook* p. 116; 1933.
2. American Association of University Professors. "Required Courses in Education." *Report of the Committee of the American Association of University Professors.* Bulletin 19: 173–200; March, 1933.
3. Bachman, Frank P. "Present Certification Requirements and Implications for Teach-

ers Colleges." *Educational Administration and Supervision* 19: 104; February, 1933.
4. Baker, Frank E. "Selective Admission and Promotion for Prospective Secondary School Teachers." *Proceedings of the Institute for Administrative Officers of Higher Education* p. 52–74; 1935.
5. Barnes, C. W. "Criteria for the Selection of Science Teaching Materials." *Science Education* 19: 152–157; December, 1935.
6. Benner, T. S. "Recent Status of the Preparation for Secondary School Teachers." *Proceedings of the Institute for Administrative Officers of Higher Institutions* 22–32; 1935.
7. Bray, W. J. "The Nomenclature of Biology Courses in Teachers Colleges." *Science Education* 17: 233–235; October, 1930.
8. Bray, W. J. "The Training of Teachers of Chemistry in Teachers Colleges." *School Science and Mathematics* 33: 319–322; March, 1933.
9. Brechbill, H. "Status of College and University Offerings in the Teaching of Science." *Science Education* 18: 221–225; December, 1934, and 19: 60–65; April, 1935.
10. Cahoon, G. P., and Mackay, Minnette. "A Follow-up Study of the Teacher Training Program at the University of California." *University High School Journal* 13; June, 1934.
11. Child, Charles M. *The Psychological Foundations of Behavior.* New York: Henry Holt and Company, 1924.
12. Craig, Gerald S. "The Program of Science in the Elementary School." National Society for the Study of Education, *Thirty-first Yearbook, Part I.* 1932, *"A Program for Teaching Science"* p. 133–162.
13. Cunningham, Harry A. Unpublished data concerning the rooms, service, furnishings, equipment, and supplies used in teachers colleges in the training of intermediate grade teachers in science; unpublished data concerning the use of the same type of material facilities in the teaching of intermediate grade science in some of the best grade schools of the country; and unpublished data concerning the material facilities needed in the training of intermediate grade teachers in science as judged by a curriculum analysis of some of the outstanding courses of study in science for grades four, five, and six.
14. Curtis, F. D. "The Teaching of Science in the Secondary Schools of the North Central Association." *Science Education* 17: 5: February, 1933.
15. Curtis, F. D. *A Synthesis and Evaluation of Subject-Matter Topics in General Science.* Boston: Ginn and Company, 1929.
16. Curtis, F. D. "What Constitutes a Desirable Program of Studies in Science Education for Teachers of Science in Secondary Education?" *Science Education* 15: 14–23: November, 1930.
17. De Laguna, Grace Andrus. *Speech: Its Functions and Development.* New Haven: Yale University Press, 1927.
18. Downing, E. R. "An Analysis of Textbooks in General Science." *General Science Quarterly* 12: 509–516; May, 1928.
19. Evenden, E. S. *Summary and Interpretation of the National Survey of the Training of Teachers.* Washington, D. C.: U. S. Department of Interior, Office of Education, 1935.
20. Fitts, C. T., and Swift, F. H. *The Construction of Orientation Courses for Freshman.* Berkeley: University of California Publications in Education 2, No. 3, 1928.
21. Finley, C. W. *Biology in Secondary Schools and the Training of Biology Teachers.* New York: Teachers College, Columbia University, 1926.
22. Gray, J. Stanley. "A Biological View of Behavior Modification." *Journal of Educational Psychology* 22: 611–620; November, 1932.
23. Gray, J. Stanley. *Psychological Foundations of Education.* New York: American Book Company, 1935.
24. Gray, J. Stanley. "Is American Education Appropriate for America?" *Educational Administration and Supervision* 19: 309–316; April, 1933.
25. Gray, J. Stanley. "What Sort of Education is Required for Democratic Citizenship?" *School and Society* 42: 353–359; September 14, 1935.
26. Havighurst, H. E. "Survey Courses in the Natural Sciences." *American Physics Teacher* 3: 97–101; September, 1935.
27. Henzlick, H. E. "Reports Relating to the General and Specialized Subject-Matter Specialization of Secondary School Teachers." *North Central Association Quarterly* 10: 219–255; October, 1935.
28. Herrick, C. Judson. *The Thinking Machine.* Chicago: The University of Chicago Press, 1929.
29. Hoke, H. L. "Giving the Teachers College Slant to Academic Subject-Matter." *Educational Administration and Supervision* 20: 392–396; May, 1934.
30. Hunter, G. W. *Science Teaching.* New York: American Book Company, 1934.
31. Hurd, A. W. *Summary of Analysis Blanks Returned in the Investigation of Teacher Training in Science.* New York: Institute of School Experimentation, Teachers College, Columbia University, Mimeographed, 1932.
32. Hurd, A. W. "Professionalized Subject-Matter in Teacher Training." *Science Education* 16: 238–243; February, 1932.
33. Hurd, A. W. "Some Aspects of the Education of Teachers of Science in Teachers Colleges and Normal Schools." *Educa-*

tional Administration and Supervision 20: 35–44; January, 1934.

34. Hurd, A. W. "An Analysis of Some Professionalized Subject-Matter Courses in Science in Teacher Training Institutions." *Science Education* 17: 277–280; December, 1935.
35. Hurd, A. W. "Professionalized Subject-Matter Courses in the Education of Science Teachers." *Educational Administration and Supervision* 19: 173–180; March, 1933.
36. Hurd, A. W. "Summary of Factual Questionnaire on the Training of Prospective Teachers in Science." *Science Education* 16: 134–139; December, 1931.
37. Inman, J. H. "The Training of Iowa High School Teachers in Relation to the Subjects They Teach." *University of Iowa Studies in Education* 4, No. 9; 1928.
38. Jean, Frank C. "Preparation of Teachers of Science to Meet the Needs of the New Program." *National Education Association Proceedings.* 1935: 445–446.
39. Johnson, P. O. *Curriculum Problems in Science at the College Level.* Minneapolis: The University of Minnesota Press, 1930.
40. Judd, C. H., Coffman, Lotus D., and Robbins, W. W. *Report of the Committee on Program of Graduate Study which Institutions of Higher Education Should Organize for the Preparation of Secondary School Teachers.* Chicago: Association of American Universities; November, 1936.
41. Judd, C. H. "The Systematic Organization of Courses in Education." *School Review* 42: 578; October, 1935.
42. Kizer, G. L. *Subject Combinations in High School Teachers Programs in Oklahoma.* Stillwater, Oklahoma: Oklahoma Agricultural and Mechanical College, Special Series Bulletin No. 1: January, 1928.
43. Knox, W. W. "The Training of Science Teachers." *New York State Education* 20: 542–543 and 587–589; April, 1933.
44. Koon, C. M. "Films in Science Instruction." *Science Education* 19: 12–13; February, 1935.
45. Land, Adele H. "The Comparative Merits of the Liberal Arts College and the Teachers College in the Education of High School Teachers in the United States." *Educational Administration and Supervision* 21: 381–391; May, 1935.
46. Leker, W. R. "The Articulation of General Science with Special Sciences." Curtis F. D. *Second Digest of Investigations in the Teaching of Science.* Philadelphia: P. Blakiston's Son and Co., 1931. 57–80.
47. Ligon, M. C. "Training and Teaching Combinations of Teachers in Accredited Secondary Schools of the South." *School Life* 15: 44–45; November, 1929.
48. McDaniel, J. W., and Ewert, W. van V. "Single Unit Courses in Orientation." *The Junior College Journal* 4: 253–255; February, 1934.
49. Mead, A. R. *Supervised Student Teaching.* Richmond, Virginia: Johnson Publishing Company, 1930.
50. Meister, Morris, et al. "Science Rooms and Their Equipment." National Society for the Study of Education, Thirty-first Yearbook, Part I, 1932, *A Program for Teaching Science:* 281–303.
51. Morrison, J. Cayce. "A Generalist Looks at Science in the Elementary Schools." *Teachers College Record* 37: 282–289; January, 1936.
52. National Society for the Study of Education. *A Program for Teaching Science.* Thirty-first Yearbook, Part I, 1932: 331–332. Bloomington, Illinois: Public School Publishing Company, 1932.
53. North Central Association of Colleges and Secondary Schools. *North Central Association Quarterly.* June, 1930; June, 1935; April, 1938.
54. Palmer, E. Laurence. "What Constitutes a Desirable Program of Studies in Science Education for Teachers of Science in the Elementary School?" *Science Education* 15: 101–110; January, 1931.
55. Pannell, H. C. *Preparation and Work of Alabama High School Teachers.* New York: Teachers College, Columbia University, 1933.
56. Peet, V. W. "The Training of High School Science Teachers with a Suggested Curriculum." *Science Education* 17: 199–202; October, 1933.
57. Peik, W. E. *The Professional Education of High School Teachers.* Minneapolis: University of Minnesota Press, 1930.
58. Persing, E. C. "Present Objectives in Biology." *Science Education* 17: 24–34; February, 1933.
59. Presson, John M. "Achievement Tests in Biology for Secondary School Use Based Upon an Analysis of the Content of the Subject." Curtis, F. D. *Second Digest of Investigations in the Teaching of Science.* Philadelphia: P. Blakiston's Son and Co., 1931: 67–80.
60. Powers, S. R., and Manzer, J. G. "Equipment for School Science Rooms." *American School and University.* New York: American School Publishing Company, 1931.
61. Powers, S. R. "What Are Some of the Contrbiutions of Science to Liberal Education?', National Society for the Study of Education, Thirty-first Yearbook, Part I, 1932. *A Program for Teaching Science:* 27–40 and 59–75.
62. Pruitt, C. M. "Academic Requirements Necessary to Teach Science." *Science Education* 17: 48–55 and 112–117; February and April, 1933.

63. Reed, Rufus D. "Range of Subjects Taught, Teaching Load, and Preparation of the Science Teachers of New Jersey." *Journal of Chemical Education* 8: 326–343; February, 1932.

64. Rowland, A. L., and Hill, C. M. "Proposal: That the Professional Preparation of High School Teachers be Elevated to a Post-College Level, and that the Contributors of the Liberal Arts Colleges to the Preparation of High School Teachers Be Confined to Undergraduate General Education, While that of Teacher Preparing Institutions Be Confined to Post-Collegiate Professional Education." *Eastern States Association of Professional Schools for Teachers, Proceedings,* 1934: 103–130.

65. Rugg, E. U. "Issues in Teacher Education: Suggested by Analysis of Permanent Record Charts of Students in Selected Teachers Colleges." *Journal of Educational Research* 27: 161–178; November, 1933.

66. Rugg, E. U. "Teacher Education Curricula." *National Survey of the Education of Teachers.* Bulletin 1933, No. 10, vol. III. U. S. Department of Interior, Office of Education.

67. Rulon, P. J. *Sound Motion Pictures in Science Teaching.* Cambridge: Harvard University Press, 1933.

68. Shouse, J. B. "Certification as an Element in the Selection of Teachers." *Educational Administration and Supervision* 20: 462–466; May, 1934.

69. Siedle, Theodore A. "Trends in Teacher Preparation and Certification." *Educational Administration and Supervision* 20: 193–208; March, 1934.

70. Sisson, E. O. *Education for Freedom.* New York: The Macmillan Company, 1926.

71. Stewart, A. W. "Measuring Ability to Apply Principles." *School Science and Mathematics* 35: 695–599; October, 1935.

72. Suhrie, Ambrose L. *Problems in Teacher Training.* New York: New York University Book Store, 1932.

73. Van de Voort, Alice Maria. *The Teaching of Science in Normal Schools and Teachers Colleges.* New York: Teachers College, Columbia University, 1927.

74. Watkins, Ralph K. "The Training of High School Science Teachers in Terms of the Market." *Science Education* 20: 56–60; April, 1936.

75. Watkins, Ralph K. "An Analysis of the Types of Scientific Method Used by the Layman in Typical Out-of-School Situations." *School Science and Mathematics* 34: 804–810; November, 1934.

76. Weiss, Albert P. *Theoretical Basis of Human Behavior.* Columbus, Ohio: G. R. Adams and Company, 1925.

77. Whitney, R. L., and Mulholland, J. "The Relationship of Teachers College Preparation and Subjects Taught after Graduation." *School and Society* 37: 533–536; April, 1933.

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NATURAL SCIENCE SURVEY COURSES IN COLLEGES

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This article presents the results of a nation-wide study of natural science survey courses in institutions of higher learning in the United States. The study was made during the first half of 1938 for the purpose of determining the number of such courses that were being offered, and the nature, content, and methods of organizing and conducting them.

For purposes of the study, survey courses were defined as "those new types of natural science courses, often called generalized, introductory, or orientation courses, which are being introduced into colleges and universities and which contain material from two or more of the traditional subject matter departments." It will be noted that this is essentially Havighurst's [1] definition.

The data were obtained by the use of two questionnaires. The first was a return post card form which was sent to 1431 institutions of higher learning in the United States. This was all of the institutions listed in the 1937 Educational Directory [2] with the exception of those classed as "professional" and a few branch colleges. The negro colleges were included with the white student colleges and were classified and grouped under their respective categories. The second questionnaire, a more detailed one, was sent to the schools which the post card study revealed as requiring survey courses of their first or second year college students.

TABLE I

INFORMATION FROM THE POST CARD QUESTIONNAIRE

Items	Universities and Colleges		Junior Colleges		Teachers Colleges		Totals	
	Frequency	Per Cent	Frequency	Per Cent	Frequency	Per Cent	Frequency	Per Cent
1	2	3	4	5	6	7	8	9
1. Inquiries	714		473		244		1431	
2. Responses	568	79.6	336	71.0	185	75.8	1089	76.1
3. Required courses	94	16.5	31	9.2	84	45.4	209	19.2
4. Contemplated courses	67	17.4	49	20.4	19	22.3	135	19.0
5. Discontinued courses	45	9.3	12	4.2	4	2.7	61	6.7

The essential information from the preliminary questionnaire is contained in Table I.

Of the 1089 that responded 209, or 19.2 per cent (see Table I), had one or more survey courses in natural science which were required of their first or second year students. No very great difference existed

[1] Havighurst, Robert J., "Survey Courses in the Natural Sciences." *The American Physics Teacher* 3: 97–101; September, 1935.

[2] Studebaker, J. W., *Colleges and Universities.* Bulletin No. 1, 1937. United States Office of Education, Washington, D. C., 1937.

between the per cent of universities and colleges and the per cent of junior colleges that required these courses. It was found, however, that the teachers colleges have adopted the survey plan to a much greater degree than either of the other two classes of colleges. This strong trend on the part of teachers colleges is probably due in part to the growing recognition that teachers need a broad academic training.

It was found that 135, or 19.0 per cent, of the respondents were contemplating a program of survey courses. If the percentiles in items 3 and 4 of Table I be added, we find that a total of 38.2 per cent were either offering survey courses or were planning to offer them.

Although some survey courses have been discontinued it is the belief of the authors that many of these 61 courses which were found to have been discontinued were not survey courses in the true sense, but were rather the old style orientation courses designed to assist the student to adjust himself to college life, and to assist him in making vocational plans. These orientation courses are now giving way in most institutions to various types of guidance programs.

Of the 209 institutions to which the detailed questionnaire was mailed, 177, or 84.7 per cent, responded. The following data are from these replies.

Very few (18, or 10.6 per cent) of the respondents were dissatisfied with their survey courses in general. Of these eighteen but five said that if they were to change they would return to the traditional courses.

Substantial progress was made in the growth of the natural science survey course movement from 1926–1932; however, the period of rapid growth began in 1933. From 1932 to 1937 inclusive, 77.8 per cent of all survey courses from which our data were compiled, were established.

In regard to the use of textbook and reference materials, the common practice was to select a basic textbook and supplement it with reference materials. This practice was followed by 71.8 per cent of the schools. Twenty per cent used no basic textbook, while 8.2 per cent follow a basic text without resorting to the use of supplementary materials.

Laboratory work was required by 33.5 per cent of the colleges answering the questionnaire, and 28.1 per cent have laboratory facilities available so that students may do laboratory work if they so desire. Of those that require laboratory work 46.4 per cent require two hours of laboratory work each week.

In respect to class room procedures, 94.2 per cent used a combination of lectures and class discussions. Only .6 per cent depended wholly upon class discussions, while 5.2 per cent indicated that they devoted the entire class time to lectures by the instructor.

Table II shows the extent to which certain teaching aids were used. The number and per cent of the respondents using each one are also given.

TABLE II

TEACHING AIDS

Aids	Frequency	Percent
1	2	3
1. Demonstrations by the instructor	168	97.1
2. Field trips	106	61.3
3. Lantern slides	134	77.5
4. Film strips	56	32.4
5. Silent motion pictures	94	54.3
6. Sound motion pictures	54	31.2
7. Charts	164	94.8
8. Models	150	86.7
9. Museum specimens	151	87.3

One hundred two physical science courses, 91 biological science courses, 57 integrated science courses, and 6 composite courses were found. The term "integrated" science course was used to designate courses which include material from both the physical and the biological science

fields; a "composite" course was defined as one which includes material from other fields as well as science. It is evident that there is little tendency to integrate beyond the confines of natural science.

It was found that only 13.2 per cent of the respondents had specialists teaching the aspect of the courses pertaining to their special field as is notably done at the University of Chicago. The common practice is to have a physical scientist teach the physical science part of the course and a biologist teach the biological science part. Thirty-one and nine-tenths per cent of the respondents indicated that they experienced difficulty in securing qualified teachers for the courses. The following remarks were selected as pertinent in this connection.

1. "Much difficulty in securing qualified teachers, both as to subject matter mastery and ability to teach. These are our hardest courses to teach."
2. "Find that teachers who can handle the sciences with this kind of approach are very scarce. They are in the nature of products of accident and must be discovered from among the masses."
3. "It would be almost impossible to find one person well enough grounded in all the sciences to teach a survey course covering all branches of science."
4. "Practically have had to train our own. Our teachers have seldom been prepared in all fields of physical science courses. With a definite text to follow and with the help of their colleagues they soon get the material in hand."

It was found that a wide range existed in the size of class sections. However, 57.1 per cent had classes of from 25–49 in number. Sizes ranged from less than 25 to over 350. Six and one-tenth per cent followed the practice of breaking up their large lecture sections once or twice each week into small discussion groups.

Only 8.6 per cent of the respondents divided the students on the basis of achievement or ability. In regard to the advisability of this practice, considerable difference of opinion existed as may be seen from the following quotations:

1. "It would be advisable."
2. "Should be divided."
3. "Division highly desirable, but not yet worked out."
4. "I do not believe it is psychologically sound to separate beginning students on the basis of I. Q."
5. "We have tried sectioning the students but gave it up as not worth the effort. The stimulation for the poor students is gone and the slow classes are too deadly on the professors."

In regard to transferring credit for survey courses to other colleges and universities, 29.0 per cent of the schools indicated that they had experienced difficulty. But 3.8 per cent, however, said that these refusals were frequent enough to be serious.

Perhaps the most interesting and important part of the study had to do with the objectives of survey courses and the methods of attempting to reach these objectives. Table III contains four objectives that were set up in the questionnaire and the per cent of the respondents that checked each.

TABLE III

OBJECTIVES OF SURVEY COURSES

Objectives	Frequency	Percent
1	2	3
1. The acquirement of pure science facts	58	33.5
2. The acquirement of generalized understandings	161	93.1
3. The acquirement of skill in valid and reliable thinking	156	90.2
4. The acquirement of socially acceptable scientific attitudes	132	76.3

The respondents were asked to check either that the principle objective of their course was the acquirement of pure science on the part of their students or that it was the acquirement of generalized understandings. In other words they were asked to choose between objectives 1 and 2 in Table III. It can be seen from this table

that 93.1 per cent checked the second alternative. Of the 58 that checked the first, 41 also checked the second. Evidently a considerable number felt that these two objectives could not be separated. In fact several stated that in their judgment this could not be done.

The next logical step was to determine what methods were used in attempting to reach these objectives. In determining the methods used to develop skill in thinking, the two suggestions listed in Table IV were given and the respondents were asked to add other methods which they had used. Table IV gives these two suggestions and the number and per cent that said they used these methods.

TABLE IV

METHODS EMPLOYED TO DEVELOP SKILL IN THINKING

Methods	Frequency	Percent
1	2	3
1. Have the students follow the steps in reflective thinking as they solve problems	110	70.1
2. Have the students set up their own problems and solve them	89	56.7

It is evident that the problem of teaching people to think is very difficult and that there is no common agreement in regard to it. In fact, the returns show such a diversity in the methods of attack that one could say with assurance that this aspect of science education is in a confused state. The following quotations, taken as representative of the methods proposed by the respondents for training students to think, will support this statement. The figure after each statement indicates the number of schools making that statement.

1. Have students apply the principles learned to life situations—5
2. Have students work out projects—4
3. Have students do research—2
4. Use of work books—2
5. "Have them discuss definitely worded problems with other men on the faculty."—1
6. "Limits and unsolved problems of science are stressed."—1
7. "Written quizzes."—1
8. "Many thought questions asked. No specific steps pointed out in thinking."—1
9. "Teach good sound science but motivate better than traditional courses."—1
10. "Study and discuss the historical phases of science knowledge."—1
11. "Check back on incorrect conclusions to see where reasoning is faulty."—1
12. "Require that they select concepts from their readings, illustrate, describe and apply in written form."—1
13. "The main thing is to get them to think. I have not felt any one plan applies at all times."—1
14. "Encourage free discussions of results and methods."—1
15. "By stating or proposing problems and then by questioning, lead the student toward the solution."—1
16. "Emphasize 'scientific method' throughout both class and laboratory work."—1
17. "We place in the students' hands a full outline of the course, with the daily assignments and sets of questions on each."—1
18. "Have student list accepted, commonplace ideas about a subject, i.e., lightning, then find out what their scientific validity is."—1
19. "Attempt to teach 'scientific method' by a study of some of the great theories of science, as the kinetic molecular theory."—1
20. "I do not believe formalized methodology to be valuable in this connection. The attitude adopted in the discussion groups endeavor to make for thoughtfulness."—1

As a first step in determining what was being done to develop proper scientific attitudes, the four possibilities listed in Table V were suggested. As may be seen by examining this table, the majority said they used each of these four methods.

The development of proper scientific attitudes is coming to be recognized as one of the very desirable outcomes of science education. The returns on the questionnaire indicate that there is as little agreement among teachers as to how to proceed in this area, as there is in that of teaching people how to think validly. The respondents were asked to add other methods which

TABLE V

METHODS EMPLOYED IN ATTEMPTING TO DEVELOP SCIENTIFIC ATTITUDES

Methods Employed	Frequency	Percent
1	2	3
1. Study the lives and works of great scientists	146	85.9
2. Study instances of superstition and misconception in literature and everyday life	139	81.8
3. Find instances in their own lives in which desirable scientific atitudes have been either operative or disregarded	132	77.6
4 Read general science literature extensively	133	78.2

they employed in this connection and the following were among the suggestions offered:

1. Have students apply the principles learned to everyday life situations—9
2. Have them observe closely natural phenomena—9
3. Have students evaluate advertisements, scientific literature, and sources of information—5
4. Have project activity or hobby—4
5. Listen to scientific lectures—4
6. Have class discussions—3
7. "Have class discussion on attitudes regarding instances in connection with work in which desirable attitudes have been observed or disregarded"—1
8. "Encourage students not to accept scientific statements without definite proof."—1
9. "Learn to organize, to take good outline notes."—1
10. "Hand in comprehensive paper at end of term on some special topic that interests students."—1
11. "We endeavor to have students keep track of some recent scientific development."—1
12. "Visit museums, factories, etc."—1
13. "Daily oral reports on current scientific topics of interest."—1
14. "Give each student, each week for two months an issue of Science News Letter and call attention to articles in it that deal with things we have considered during the course."—1
15. "Students sometimes asked to go into the laboratory and check their ideas and interpretations by experiment."—1
16. "We require a careful study of the four texts indicated."—1
17. "I try to develop certain specific attitudes and skills in the laboratory."—1
18. "Stating fundamental principles such as neutralization and having students give examples."—1
19. "Bulletin board provided for newspaper and magazine articles relating to current science. Students encouraged to contribute to this."—1
20. "Encourage students to look for logical thinking in science."—1

An attempt was also made to learn the difficulties encountered in conducting the courses. Some of these are listed below.

Difficulties	Frequency
1. Lack of time..................	47
2. Lack of equipment and reference materials	25
3. Lack of suitable textbook.......	17
4. The problem of laboratory work	14
5. Lack of satisfactory instructors..	11
6. Large size of classes............	11
7. Courses are too superficial.......	11
8. Lack of homogeneous grouping of students	11
9. Lack of help..................	9
10. Courses are too technical........	3

The following conclusions can be made as a result of the analysis of the data:

1. Two hundred nine of the institutions responding, or 19.2 per cent required survey courses in natural science in either the freshman or sophomore year.

2. The indication was that the survey course movement would continue to grow since about 19 per cent of the institutions in which they have not been offered are now contemplating them.

3. The instructors and administrators of these courses were for the most part satisfied with their survey course plan and would not care to return to the traditional courses.

4. The majority of schools had as their chief objectives the acquirement on the part of the student of scientific attitudes, skill in thinking, and generalized understandings.

5. There was ltitle agreement among instructors and administrators as to how

to reach the objectives set up for their courses.

6. Few of the schools had serious difficulty in transferring credits for survey courses to other institutions.

7. Difficulty was experienced in securing qualified teachers for these courses.

8. Few schools divided their students into sections on the basis of ability or achievement.

Since there is strong indication that the survey course movement will continue to grow, certain implications may be drawn with respect to those institutions that are adopting this plan:

1. Teachers of broader scientific training and successful experience must be provided.

2. Survey science teachers must work out on the basis of tested procedures methods by which general understandings, the habit of scientific thinking, and desirable scientific attitudes may be inculcated.

3. Special training dealing with the materials, methods, objectives and testing procedures in survey courses may have to be provided for prospective teachers of these courses.

BIBLIOGRAPHY

1. Allen, John S. "An Introductory Course." *Journal of Higher Education* 6: 410–414; November, 1935.
2. Bate, L. F. "Orientation in Chemistry." *Science Education* 19: 170–172; December, 1935.
3. Bossard, James H. S. "Educational Guidance and the Orientation Course." *School and Society* 30: 216–223; August 17, 1929.
4. Boucher, C. S. *The Chicago College Plan*, Chapter IV, pp. 43–46, Chapter IX. The University of Chicago Press. Chicago, 1935.
5. Havighurst, Robert J. "Survey Courses in the Natural Sciences." *The American Physics Teacher* 3: 97–101; September, 1935.
6. Hufford, Ralph W. "A Science Survey." *School and Society*, 38: 276–279; August 26, 1933.
7. Hurd, A. W. "Tendencies Disclosed by Curriculum Investigations in Higher Education and their Implications for Science Teaching in Elementary and High Schools." *Science Education* 21: 147–151; October, 1937.
8. Johnson, B. Lamar. *What About Survey Courses?* Henry Holt and Company, New York, 1937.
9. Johnson, William H. "Public Junior Colleges of Chicago." *Junior College Journal* 8: 231–234; February, 1938.
10. Jones, E. S. "The Value of a College General Science Course." *School and Society* 27: 607, 608; May 19, 1928.
11. Jones, O. G. "Modern Scholasticism." *School and Society*, 31: 337–339; March 8, 1930.
12. Matherly, Walter J. "Comprehensive Courses." *Journal of Higher Education* 7: 124–133; March, 1936.
13. McDaniel, J. W., and Ewert, W. V. "Single-unit Courses in Orientation." *Junior College Journal* 41: 253–255; February, 1934.
14. Newmann, H. H. "Orientation Course." *Journal of Higher Education* 2: 121–126; March, 1931.
15. Norris, Will U. "Survey Courses in Physical Sciences for College Freshmen." *Journal of Chemical Education* 10: 631–634; October, 1933.
16. O'Brien, F. P. "Orientation in College Instruction." *Junior College Journal* 3: 287–289; March, 1933.
17. Piper, R. F. "Freshman Preferences, Studies in College Orientation." *School and Society* 41: 374–376; March 16, 1935.
18. Pruitt, Clarence M. "Survey Courses in the Natural Sciences." *Science Education* 21: 10–16; February, 1937.
19. Sibley, R. P. "Orientation Courses." *School and Society* 40: 373–377; September 22, 1934.
20. Stowe, A. R. M. "Orientation Courses." *Journal of Higher Education* 5: 175–179; April, 1934.
21. Thayer, V. T. "Education for Orientation." *Progressive Education* 10: 386–393; November, 1933.
22. Ward, Paul W. "Student Opinion Concerning Two Survey Courses." *School and Society* 36: 15, 16; July 2, 1932.
23. ———. "Teaching Methods in Survey Courses." *School and Society* 38: 121, 122; July 22, 1933.
24. ———. "Attitudes of Average and Superior Students Toward Survey Courses." *School and Society* 40: 398, 399; September 22, 1934.
25. ———. "Survey Courses at Syracuse University." *School and Society* 46: 760–762; December 11, 1937.
26. Winokur, Morris. "A Survey of Generalized Science Courses in Institutions of Higher Education." *Science Education* 20: 132–140; October, 1936.
27. Wrenn, C. G. "Origin and Present Status of College Orientation Courses." *School and Society* 31: 336, 337; March 8, 1930.

EXPERIENCES IN A STUDY OF SOIL

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A group of second grade children and their teacher spent an entire year in the study of interesting aspects of science. Some of the topics studied were: living things, magnetism, air, water, the earth, and soil. In this article a description of the unit on soil is to be discussed.

The group started work on the soil as one phase of the study of the earth. We had discussed the question of what makes up the earth, and soil, water, and air were mentioned. It was decided that there were many things about soil that we did not know. Some of the questions asked by the children were:

> What is soil?
> How is soil made?
> Was soil always here?
> Is soil the same all over the world?
> What makes days when the air is full of dust?
> Why is some soil light and some soil dark?
> What makes good soil for plants?

The questions were printed in large manuscript letters on a chart and placed on the wall of the classroom. There were our questions. Now, how could we find the answers? The children suggested asking mothers and fathers, asking people who had gardens or farms, reading in books, and doing experiments.

The first question to be considered was "What is soil?" We had all seen soil; we had played in it with our hands and feet; we knew that it covered all the earth. We could see it as we took walks and drives in the country. Vegetables and farm crops of all kinds grow in the soil. Some fields were covered with grass and grass grows in soil. The large trees in the woods grow in soil. In the city, where our school is, we could see that the school and the houses around it were made on top of the soil. Our playground is made of soil. In a stream near the school we could see soil at the bottom of the creek. Some of the boys knew there was soil at the bottom of rivers, lakes, and even the ocean. Soil is all around us, and we decided to get some soil and find out what it really is.

The children brought in many kinds of soil. There was loam, sand, clay, gravel, and humus. We could see that all these kinds were made up of little particles. We could see that some soils were light and some dark in color. Magnifying glasses and a microscope were used in looking at the various kinds. We found out that gravel is very coarse and clay is very fine; that loam is sand and clay mixed together; that the black soil from the woods has decayed plants and leaves mixed with the sand and clay. A gardener told us that loam is the best soil for garden plants and that the black soil from the woods is best for ferns or house plants. We planted seeds in the various kinds of soil and watched them grow. We made a chart telling about the kinds of soil. It read:

> "Sand is made of large coarse shiny grains. It is not very good for plants.
> "Clay is made of very small and fine grains. It is sticky when wet.
> "Loam is made of sand and clay mixed together. It is good for farms and gardens.
> "Gravel is made of coarse pieces of rock. Roads are made of gravel.
> "Humus is made of clay and sand mixed with decayed leaves and plants. It is found in the woods. It is very rich dirt."

As the discussion had progressed, the question had arisen many times as to how soil is made. By reading in books and discussing, the children found out about these ways:

1. By Streams and Waves.

   This answer was found through an experiment. They brought in some pieces of rock, some soil from the garden, some clay from

the road, same sand from the beach, and a box of pebbles. These were all mixed together and piled in a big heap in the sandtable. Water was poured from a can on to the heap. The water flowed down all sides of the heap, washing away the fine dirt with it. Through this experiment the children learned that water carries soil along with it from place to place. They not only learned this but also that water helps to make soil. It rubs the rocks slowly against each other and tiny pieces break off. These tiny pieces are bits of rock and sand. Waves of the ocean and lake pound against the rocks and wear off the sharp edges. They break off chunks of rock and grind them into soil. We gathered pebbles from the beach and noticed how shiny and smooth they were. The water is always pounding against the rocks and grinding them into soil. Waterfalls wear away rocks by the constant falling over a cliff. This makes the rocks into soil.

2. By Water Soaking Into Cracks.

When it rains, water soaks into cracks and hollow places in the rocks. In the winter this water freezes. When it freezes, it takes up more room. The holes are not large enough to hold the ice. The ice is stronger than the rocks and breaks them apart. As they break and crack, soil is made.

3. By Wind.

The wind carries soil a long way. We have all seen dust storms. The fine pieces of dirt are thrown against rocks. They hit the rocks with great force. They grind down and polish the rock. We tried some sandpaper on some rocks to show how this could be done.

4. By Plants and Animals.

The roots of a plant can help in making soil. They wind in and out among the grains of dirt. They push into rocks and crack them apart. Pieces of soil are made as the rocks crack. Almost all plants help to make soil. Most plants lose their leaves in fall. The leaves fall to the ground, and there they lie during the winter. They rot and mix with the dirt to make good soil. We call this leaf mold or humus. Humus is very good for gardens.

Animals, too, help to make soil. Many animals burrow into the soil and move it from place to place. Insects and animals die. Their bodies decay and are added to the soil. Earthworms eat leaves and carry these down into the ground. They also dig their way through the ground eating the soil. The soil passes through their bodies and is cast out. This mixes up the soil. We tried an experiment to show what earthworms do. A large glass jar was secured and about three inches of yellow sand was put at the bottom. Two inches of garden soil was added to this. Bits of leaves were put on top of this. The soil was kept moist. The jar was covered with dark paper. We put six earthworms into the jar. We looked at the jar every few days and could see that the yellow soil was mixed with the other soil. The bits of leaves were carried down into the soil.

5. By Rain and Snow.

Rain and melting snow carry many pieces of rock. They meet other rocks carried along by other water. The pieces bump and grind against each other. They break up into smaller pieces. The edges and corners wear off. The tap, tap, tap of rain wears away rock. The rub, rub, rub of melting snow grinds rocks into soil.

The class now considered the question as to what makes some soil dark and some soil light. In the dark soil in the garden we find some pieces of plants and leaves and dead animals. This makes the garden soil rich in food value for the plants. It helps the soil to hold water needed for plants to grow. The farmer or gardener often adds manure to the soil to make it rich. This causes the soil to be dark. The soil on the beach or in some fields is light in color. This is because very little food has been supplied either by man or in a natural way.

We now studied about the kind of soil needed for plants. We found out that these things are needed to make a good farm or garden:

1. The soil must be fine.
2. It should have plant foods in it. Manure or commercial fertilizer can be added to soil to give it plant foods.
3. It should hold enough water to dissolve plant foods.
4. It should have a place for extra water to run off.

On the school ground the children made a garden. They hoed and spaded the soil. They added manure for fertilizer. They watered the gardne when needed. The extra water drained away so water did not stand on the plants. The lettuce from the garden was used for making sandwiches for a party. At this party the children gave a movie telling the things they had learned about Soil.

INTRODUCING THE SCIENCE OF CRIME DETECTION INTO THE CLASSROOM

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It is the purpose of this article to demonstrate a way by which the pupils in a classroom may be a part of a crime investigation that is both scientific, workable, and convincingly instructive. The pupils of both junior and senior high school age will frequently bring up the subject of crime detection as they see it referred to in the press, movies, and even in the comics. Many teachers think of it as an interesting subject for discussion but hardly anyone considers it practical enough for an experiment or demonstration. Most people associate crime detection only with elaborate and complicated equipment. The experiment to be described needs no special equipment and therefore can be performed in any classroom. The demonstration itself has more value than the mere sensational type of interest that many will associate with it. The experiment is scientifically designed and compels the pupils to make use of scientific methods throughout, so one can conclude that it does train for a scientific attitude.

The particular type of crime detection to be described here is the one dealing with the detection of lies. It should be explained to the pupils that there are many types of lie detectors, each of which has more or less merit. Principal among these are the *Galvanometric Method, Inspiration-Expiration Rate, Systolic Blood Pressure, Pulse Tracing,* and *Reaction Time.* In all of these cases, these devices merely attempt to determine whether the subject is telling the truth or not. They are not to be confused with the several methods that have been tried relative to making the subject speak the truth by means of a so-called "truth serum" (scopolamin or twilight sleep) or by ordinary sleep talking and by hypnosis. The literature as well as the magazines on the news stands have carried numerous articles of late, relative to the electrical images displayed by the oscilloscope when it is properly connected to the subject. They have been trying to associate certain type patterns with definite mental activities and success in this may lead to its adaptability to crime detection methods.

The principle behind practically all types of crime detection has grown from the scientific studies of emotional reactions and the manner in which they make themselves evident. For example, it has been reported that intense sensory stimulation such as burns, pricks, pinches, electric shocks, unpleasant smells, et cetera, produce so-called galvanometric deflections. This is the same as saying that they produce alterations in the electrical resistance and conductivity of the body or sections of the body. It is common to think of such a device including a battery, adjustable resistance, sensitive galvanometer, and two electrodes that may be strapped either to the subject's hands or feet in an effort to trace any deviations in the resistance between these two points. Actually in practice, the galvanometric device is considerably more complicated for instead of using batteries, an alternating current is used in order to reduce polarization effects, and then in order to make these deviations register on a galvanometer, it is necessary to use a vacuum tube circuit that can be properly balanced and adjusted for sensitivity.

Many interesting descriptions are to be found in the literature, tracing the development of these devices. The method of connecting the electrodes has involved numerous techniques among which they have

used battery jars filled with salt water into which the subject immersed either his feet or his hands. In others, the subject would cover his hands with shellac or paraffin except for a small area, before immersing them. In this way, the area in contact with the solution remained constant. Others devised splints, etc., to keep the subject from raising his hands in and out of the solution for that would alter the readings. Another made use of leather gloves soaked in a salt solution and into which were attached silver electrodes near the palm position, the whole glove being strapped firmly into place.

It might be well before going any further, to explain briefly how these techniques are used in connection with the detection of lies. In general, the subject is either asked a selected group of short, pertinent questions that can be answered with one or two words or he may be confronted only with single words. Whether they be questions or words, some of these irrelevant are given in order that the subject become at ease. When he has maintained his ease and composure for a time, it will be possible to get a good estimate of the galvanometric readings (electrical resistance of his body). After that, one can inject a question now and then relative to the crime and some of its details. If in general, the subject shows no great departure from what he has established as his normal behavior, one would assume that he was not associated with the crime. If, however, his galvanometric readings become very erratic as compared with his normal reactions, one might assume that he at least knows something about the crime in question. There are many theories attempting to account for this change in conductivity. Some explain it on the basis of secretions into the blood stream at the time of high emotional stress. Others state that nervousness is almost invariably accompanied by perspiration and that this being a salt solution, it will cause the electrodes next to the skin to make better electrical contact and hence, pass a greater amount of current. There is some basis for this last statement and with it comes a strong objection to galvanometric tests especially when the palms and other skin surfaces are used for contact. A guilty person becoming nervous would begin to perspire at the time of the significant questions. This would usually mean that the conductivity would actually show a change at a noticeably later time. This might be on the following question rather than on the significant one because sweat glands do not act in exactly a trigger-like fashion and neither do they immediately dry up their released perspiration when not activated.

Many suppose that nervous people would automatically label themselves as guilty by a lie detector. Such is not the case. The actual readings are not used, but instead only their relative values. An innocent but nervous person would probably react in rather an erratic manner throughout the test. The observer is looking for sufficiently erratic results on significant responses to set them aside from the ordinary class of responses. Only the guilty party or one very familiar with the crime in all of its details, can demonstrate these expected results and then, only on the correct set of responses.

It should be mentoined too, that no scientifically operated laboratory for the detection of crime will rely upon the results of any one of these techniques, no matter how good they believe it to be. Invariably, they will make use of many of them and rather than merely looking for signs of guilt from any one, they will only look with suspicion on those cases that present verification from a majority of the methods employed.

The measurement of the inspiration and expiration rate is another technique that has been rather widely used. It actually results in a graph showing the breathing of the subject during the time that the various questions are being asked. In common use, a pneumatic tube is placed around

the chest of the subject and this in turn is connected by tubing to a recording device. The recording device is operated by a clock mechanism so that the curves and dips drawn on the tape portray the extent of regularity of the subject's breathing. As one can readily realize, the guilty subject will have a tendency to "catch" his breath a bit when confronted with a pertinent question. One might guess that the guilty person could easily regulate and control his breathing. However, many subjects have made a study of the operation of these various devices hoping to feign innocence and still they have been easily detected.

Pulse tracings and measurements of systolic blood pressure seem to have won for themselves rather general praise. The action of the heart cannot be controlled at will and if the question or picture of the crime is such as to alter the heart action, it is impossible for the subject to do anything about it. Analysis of the pulse tracings on an electro cardiograph elicit the information that the examiner wants to know. At first, it was necessary to take measurements of the blood pressure using a sphygmometer and stethoscope. That, however, was slow and did not offer a continuous reading. It is thought that some of the pulsations that make up the complete cycle of a pulse beat may be more greatly affected by nervousness and emotions than are others and for that reason, the analysis is not exactly simple.

The study of one's reaction time and its relation to lies is the one that has been found extremely useful by many experimenters and the author has found it particularly easy to duplicate in the classroom. Its advantages are numerous and it also lends itself readily to the inclusion of other devices and techniques which may be consulted for further and more conclusive evidence.

For classroom demonstration, it is of course necessary that the crime be an artificial one. In other words, it is necessary that a subject be selected and then given directions as to the crime he is to perform. Three volunteers are allowed to select envelopes which are labeled as follows:

"BE SURE THAT YOU:

"Take a book with you when you leave this classroom.

"Do not try to see what the others do.

"Do not talk to anyone, and certainly to no one about this experiment.

"Come back and be waiting outside the door to be called, in about FOUR minutes."

Two of these three volunteers when they opened the envelopes, found a message similar to the following:

"You have been fortunate enough to select very innocent duties. You are not the guilty person and do not try to determine which one is guilty. Some of the others, in fact, even the guilty one will have instructions that may lead him either into your company or into the same room.

"Do not converse with anyone and it is suggested that perhaps it might be a good idea for you to waste these few moments by glancing through whatever book you happened to bring. Above all, do not talk with any of the members of your class, whether they be guilty or innocent. Do not try to check up on their other movements.

"It is suggested that you do not spend these minutes in the hall for that would make it difficult for the other members to move about without your detection. If you are a boy, go either to the boys' clubroom or to the wash room. If you are a girl, you might possibly go to the girls' clubroom. *Do not leave the school building.*

"The only time that all of you who leave the classroom will be together, is when you are waiting to be called and are sitting just outside the classroom door. Do not try to hear what is going on inside for a knowledge of that might disturb the results."

One of the volunteers found a message similar to the following:

"FOLLOW THE DIRECTIONS VERY, VERY CAREFULLY. READ THEM OVER THOROUGHLY NOW SO THAT YOU UNDERSTAND EVERYTHING THAT YOU WILL BE DOING AND THEN READ THEM AGAIN AND AGAIN FROM TIME TO TIME AS YOU ARE COMPLETING THE VARIOUS STEPS IN THESE DIRECTIONS. IT IS IMPORTANT THAT EACH DETAIL BE FIRMLY FIXED IN YOUR MIND AND YOUR COOPERATION IS DESIRED IN THIS EXPERIMENT.

"Take the enclosed key and let yourself into ROOM 207 and go to MR. SMITH'S DESK. In the upper-right hand DRAWER of his DESK, you will find a ring of CAR KEYS.

"Pay no attention to anyone you may see in the halls and try not to let anyone notice you letting yourself into MR. SMITH'S OFFICE. Be particularly careful not to let either of your classmates see where you go or what you do.

"Take MR. SMITH'S KEYS and go down to the PARKING SPACE and find MR. SMITH'S BUICK COUPE. It is the BLUE COUPE parked near the street entrance. You will find the BLUE BUICK COUPE locked but select the KEY and let yourself in.

"Assuring yourself that no one is around, search through the FORWARD DASH COMPARTMENT and you will find a BILL FOLD with MR. SMITH'S NAME on the outside. Look inside and you will find a FIVE DOLLAR BILL belonging to MR. SMITH. Again assuring yourself that no one is watching, put the FIVE DOLLAR BILL in your POCKET, close the DASH COMPARTMENT, get out of the BLUE COUPE, and lock it.

"Take the CAR KEYS back to MR. SMITH'S OFFICE placing them carefully in the DESK just as you had found them. LOCK the door to ROOM 207 when you leave.

"READ ALL OF THESE DIRECTIONS ONCE AGAIN COMPLETELY, AND RETURN AND WAIT IN ONE OF THE CHAIRS OUTSIDE THE CLASSROOM. THE OTHERS WILL BE WAITING THERE ALSO SO BE CAREFUL NOT TO TALK TO THEM."

While the volunteers are doing as was directed, the instructor has an opportunity to complete the setting in the classroom and explain to the pupils the part that each will play in this detection of crime. It is explained to the pupils that fifty words have been chosen. The instructor explains that he intends speaking each of these words to each of the suspects as they come up for examination (only one suspect being in the room) and that each will answer or reply with the first word that comes into his mind. For example the word, "ham," might bring up the associated word, "egg." The word, "hat," might easily suggest the word, "head," etc. Each pupil in the room will have a paper in front of him and he will have numbered down through fifty and have a separate column for each of the suspects so that he can make a tabular record of his observations. Of these fifty words, forty have been carefully chosen because of their simplicity and general nature. Ten have been carefully selected because they refer in some way to the crime in question. These ten significant words are scattered throughout the entire list. This group of fifty words divides itself into three classifications. There are the significant words or those dealing with the crime, the post-significant words or those, each of which immediately follows a significant word. In this case, there will be ten significant words, ten post-significant words and thirty of the truly non-significant words, which in general are all of those not falling into the first two classifications.

The instructor will have acquainted the pupils with the numbers of those words which are significant in order that they may star them on their lists. When actually examining a suspect, the instructor will repeat the first word and simultaneously start a stop watch. As the suspect responds, he will stop the watch and hand it to one of his aids who will record the time that has elapsed. Picking up another watch that is reset and ready, the instructor immediately "fires" the second word at the suspect, starting the stop watch and following the same procedure. While this is going on and one group of pupils is compiling the actual elapsed time of response for the three classes of words, another group of pupils has been selected to record the words that each suspect gives. Still another group of pupils will be observing the suspect closely in an effort to discover whether he displays any observable nervousness on the significant and post-significant words. If one has arranged an electrical device for some sort of galvanometric measure, a lecture table galvanometer may be used and another group in the class, may have as their duty, the recording of these galvanometer values.

It is important that each group under-

stands exactly what its duty is. Only one suspect at a time is under examination and it adds to the seriousness of the situation to go through some of the legal formalities before examining each prisoner. Lie detectors may not be used without the suspect's permission. It is well of course, to give each suspect several examples of simple words and let him try responding with the first word that comes into his mind. A little practice will be good economy in the long run otherwise one may have to stop the experiment in the middle to further explain some of the details. This will make it difficult or even impossible to use all of the data.

When the suspects have been examined, the pupils classify their observations. Those who have recorded the response times find the average for each of the three different classifications of words and it is not uncommon to find results similar to the following:

AVERAGE TIME OF RESPONSE

	Suspect "A"	Suspect "B"	Suspect "C"
Non-significant words	1.3 sec.	3.5 sec.	1.6 sec.
Significant words	1.2 sec.	3.8 sec.	3.1 sec.
Post-significant words	1.4 sec.	3.2 sec.	3.3 sec.

It is easy to see from the above data that suspect "A" takes no more time to answer the significant or the post-significant words than he does the non-significant ones. This indicates that he has truthfully and readily given the first words that have come into his mind at all times. Suspect "B" has taken longer than suspect "A" to answer all of the words, which in itself is no indictment. All people do not respond as readily as do others. It is clear to see though that "B" has recognized no difference between either of the word classifications. That would label him as not guilty.

In the case of suspect "C," it is observed that he has taken about twice as much time on the average, to respond to the words that referred to the crime as well as to those coming immediately after. That would indicate that instead of responding and taking the chance of possibly giving himself away by a related word, he has chosen to wait until some other association not so closely associated has come to his mind. All this takes time and that is recorded by the stop watch. It should be observed that the post-significant words differ from the non-significant words in much the same way that the pertinent, significant words do. This is explainable for the guilty person after hearing one word dealing with the crime, is on his guard and responds as though he were expecting another.

The significant words are chosen from the nature of the crime or in this artificial case by reference to the written directions. Such words as Mr. Smith, desk, keys, lock, Buick, coupe, blue, five, dollar, bill, room, number 207, office, and others may serve as significant words. When the guilty individual is confronted with the word, coupe, one need not be surprised when he replies either Buick, Mr. Smith, or blue. However, he will not necessarily reply with such a related word if he has hesitated in his response long enough to think of something else. However, in that case, the stop watch catches him.

It is the duty of the pupils in the various groups to weigh their observations and evidence and then have their spokesman present their verdict and their reasons. After all of the evidence is presented, it is well to allow the pupils additional opportunity for revising their verdict because in light of all of the evidence, new inferences may be drawn.

The pupils will be extremely interested in this demonstration and the instructor will find that they are not only anxious but rather proficient in devising an artificial crime of their own which they will then be able to supervise by themselves. Careful attention should be given to the weighing of facts and interpretation of the data because it is here that much of the experiment's real value is to be found. It is easy to jump at conclusions and arrive at the wrong answer if one is unscientific but in

all of the writer's classes in which this has been tried, the guilty party may easily have been discovered from an observation of the data collected. A common fault that many of the pupils will make in devising their own crime is that they make the significant words unusual and much more difficult than any of the others. This causes the time of response to become longer for those and sometimes that makes it appear that everyone is guilty. That does make the analysis more difficult but even in such cases, it is usually possible to select the criminal because his percentage will be greater even though at times, the actual numerical increases may be smaller.

Stop watches may be replaced by the use of electrical or mechanical counters and it is quite satisfactory to let the observer count intervals to himself. Counted intervals may vary from one-fifth to nearly one-half a second but once he has selected a rate for counting, either of these speeds will prove quite satisfactory.

The writer has introduced this demonstration in a variety of forms into a number of science classes during the past several years. Pupils of all ages from the seventh through the twelfth grades seem equally fascinated by it. Another commendable fact is that the demonstration works well and does not necessitate an alibi or excuse when it has been completed for it always seems to yield results. This particular technique of detecting lies is usually appropriate for it is not only relatively simple to administer but it is also easy for the pupils to understand how it functions.

ON TEACHING NATURAL SCIENCE BY CORRESPONDENCE

FRED R. CLARK
Ann Arbor, Michigan

Many colleges are now offering standard courses in many fields by correspondence, yet most of them hesitate to include Natural Science subjects, such as Biology, because of a feeling that laboratory practice can not be carried out under such methods of instruction. Doubtless there is much truth in such a viewpoint but that should not entirely close the door to all science instruction by mail. The writer has done some teaching of Biology subjects by correspondence and has been able to eliminate many of the difficulties in the way of giving formal laboratory work by the use of assigned projects which the student must work out and mail to the instructor when completed, along with the rest of the work provided for in the unit. Such projects are really an individual piece of research on the student's part, especially since he must work almost entirely on his own. In fact properly devised projects put the student in direct contact with natural things, much as the laboratory was *originally* designed to do.

Projects may be of almost unlimited style and variety. For example, the instructor may ask for plant or animal collections; he may devise cards to be filled out for the observation of birds, reptiles, fish, mammals, trees, weeds, crop plants and the like; he may prepare extensive and progressive ecological studies; or may introduce the raising and growing of specimens for observation in jars, cages or cultures as the case may be.

If one is teaching a course in Systematic Botany by mail a collection of one hundred flowers to be pressed, mounted and labeled, could be asked for. This is much like the usual requirements when such work is given in residence, except that the student has to depend on his own resources every step of the way.

An introductory course in Forestry lends itself especially well to projects, investi-

gations and reports. Maps may be prepared of wooded areas; studies may be made of forest fires, erosion control, systems of management, ecological factors and the like. Reports can deal with the historical phases of Forestry, with lumbering, forest products or some phase of game management. Excellent source material for extensive reading is at hand in free government bulletins.

If one should wish to give a correspondence course in Entomology the logical project to set up would be that of an insect collection. Should the course be of taxonomic nature, a collection could follow that out by requiring that the specimens be properly classified and grouped. If however, the course followed economic lines emphasis could be placed on hosts, life cycles, and so forth. It is not necessary that supplies and materials used in projects be expensive. A case in point is that insect boxes may be made out of cigar boxes which have a sheet of box board glued in the bottom (for pinning). If specimens are well pinned and packed they will stand mailing considerable distances in such boxes. Another method is to fill a box with cotton, place the insects together with their labels upon this cotton and then to cover them with a sheet of glass or cellophane, finally binding the edges with tape. The cost of such mounts is negligible and they may be shipped any distance for inspection. Students derive much satisfaction from making collections and take great pride in bringing them to perfection. This seems especially true in the case of those who are pursuing courses by themselves as they evidently lavish all their spare time on these in the way of a hobby.

The writer believes that many Natural Science courses may be given to advantage by correspondence if the instructor will but apply a little imagination and resourcefulness to the problems at hand. New techniques of teaching may need to be developed, and these may not be quite the same as those used in resident college instruction, but if results can be obtained and the student acquires the requisite knowledge, such efforts are worthy of a trial.

Classroom Notes

Photosynthesis Apparatus.—Two minds are often better than one. Now that Mr. Raskin[1] has started the ball rolling let us put in our bit.

Some of the readers of Science Education may find interest in my experience with this demonstration. As Mr. Raskin indicates, the modern youth demands more rigorous methods of proof. They are not satisfied with experiments with too great possibilities for error.

It is true that the spark method mentioned by Mr. Raskin entails certain difficulties. However, I have been using a system incorporating a hot filament and have avoided high voltages. It has been used with much success.

The materials, aside from the bell jar, are found in any ten cent store or hardware store. The cost is nominal.

There may be many ways of lighting a candle electrically. I have used an electrically heated fiilament to light the candle used in the familiar demonstration of one of the products of photosynthesis. The burning candle consumes the available oxygen until the supply is too low to support combustion. The candle cannot be re-ignited until the oxygen supply is replenished. After photosynthesis has progressed the candle may again be ignited. This proves that oxygen was produced during photosynthesis. The apparatus may be used in any class room.

The materials needed are as follows:

1. Window glass. Approximately 1 square foot. Cost not over 15¢ at any hardware store. This is used as the base for the bell jar.
2. Nichrome wire. This is most easily obtained from the ten cent store by buying a replacement element for a toaster. About 15¢ should cover this item. A piece of the element about one inch long is snipped off with a pair of pliers. This inch length is all that used. The rest may be saved for some other purpose.
3. Copper wire. No. 18 or heavier of magnet or annunciator type.
4. A photosynthesizing plant. The geranium is easily obtained from the home of some class member.
5. Transformer. It shouldn't cost over $1.50 at any hardware store.
6. Switch. An ordinary light switch is excellent.
7. Solid rubber stopper. Rubber makes a beter seal. The wires are pushed through the stopper and then the top is sealed with beeswax, sealing wax, or de Khotinsky cement.
8. Candle. It should be at one side so that the flame will not injure the plant.
9. Bell jar. Preferably one with a small opening at the top.

The laboratory set-up is shown in the diagram of figure 1. The bare copper wires are pushed

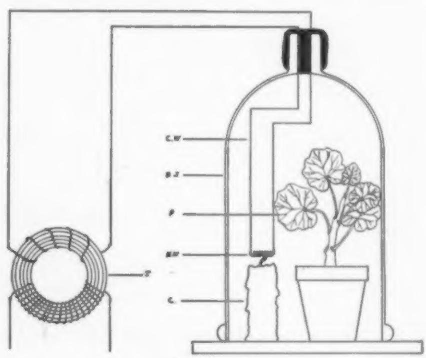


FIGURE 1

through a solid rubber stopper. The ends are twisted about the ends of an inch length of nichrome wire. It is wise to loop the nichrome filament about the candle wick once. The candle is fastened to the glass plate with a drop of liquid paraffin from the burning candle. The bell jar is placed over the plant and candle and sealed to the glass plate. The copper wires are adjusted so that the nichrome wire loop is at the proper position. The stopper and wires are then sealed with bees wax, sealing wax, or de Khotinsky cement. The copper wires are then fastened to the 6-volt side of the transformer. The transformer is plugged into any 110-volt alternating current light socket. When the current is turned on the nichrome wire will become white hot and ignite the candle. Since the bell jar is not disturbed there is little possibility for leaks. The chances for failure are small.

In case one does not like to use the transformer set-up, it is possible to use the current from a storage battery or from several dry cells in series. The set-up is then that of figure 2. The switch is not shown in the diagram.

The 110-volt current should not be used directly. The short length of nichrome wire has too small a resistance and would probably blow out the fuse in the electric light circuit. However, the 110-volt current may be used as in

[1] Raskin, Abraham. "A New Method of Demonstrating the Production of Oxygen by a Photosynthesizing Plant." *Science Education* 21: 231; December, 1937.

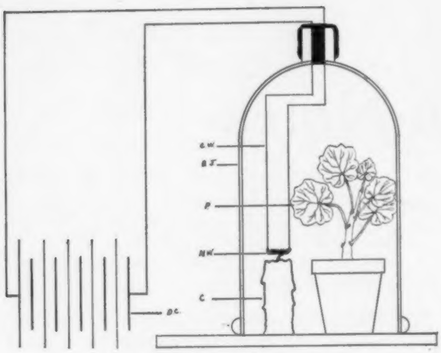


FIGURE 2

figure 3. The resistances (R) are heating elements or some heating appliances. The drawback with this set-up is the excessive heat produced by the apparatus.

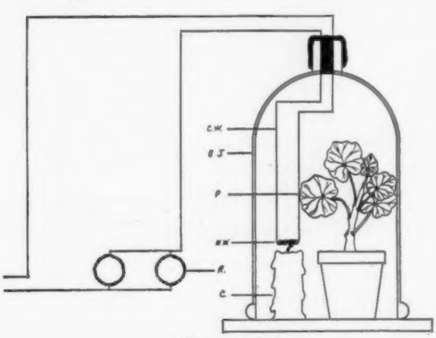


FIGURE 3

The inconvenience of using a rubber glove as described in Mr. Raskin's article is avoided. The pressure changes are minimized. Leaks are less likely. There is very litle that may go wrong with this apparatus whereas the uncertainty of cigar lighters is a standing joke.

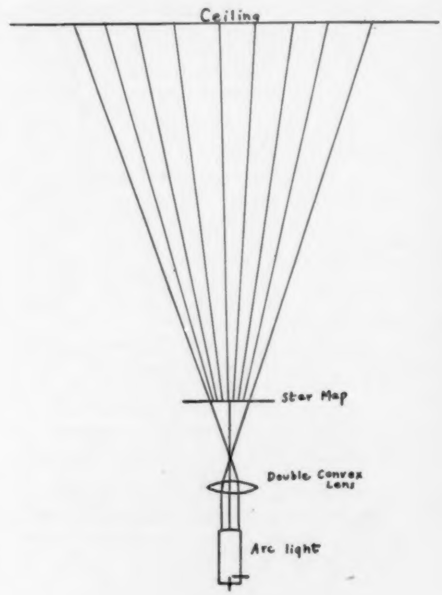
I hope this has put some tips in the hands of some teachers. Now let us hear from some one else.

FRANS VAURIO,
University of Minnesota High School

An Astronomical Aid.—The following is an inexpensive method of teaching astronomy. It has proven to be valuable and motivating in my general science classes. The equipment necessary includes (1) an arc light, or any strong source of light, and a double convex lens. These may usually be borrowed from the physics department; and (2) Any chart showing the stars of the heavens. I used "The Star Explorer," a cardboard chart, sold for 25¢.

Take a sharp instrument (a pin will do) and punch holes through the cardboard at the points where the stars are shown, making a larger perforation for alpha and beta stars.

The set-up is shown in the accompanying diagram. The double convex lens is to diverge the parallel rays of light coming from the arc light. The star chart should be placed beyond the focus of the lens. The projection is thrown upon the ceiling. The room should be as dark as possible.



The result I obtained was a projection of stars about 10 feet in diameter. The chart could be moved on its pivot to show the rotation of the heavens. Small wires were placed across the chart as it rotated to momentarily shut off the light passing through a performation, making a realistic "twinkling" of the stars.

GORDON M. DUNNING,
Middletown, N. Y.

Their First Scientific Project.—While attending a general science class, an idea for a project suddenly suggested itself to two boys. It was a diorama of Otto von Guericke's "famous Madgeburg hemispheres' experiment." Since it fitted into their study of air pressure, the instructor permitted them to work on the idea. The entire scene was planned, even to the most minute detail, from a picture in a physics textbook. However, before beginning work, they made sure that all necessary materials were obtainable. Below is a brief description of the project.

The mahogany stained base is constructed of three-ply wood measuring 3 by 2½ feet. To elevate this project, two wedge-shaped boards, one at each end of the longer side, are screwed to

DEMONSTRATING THAT AIR EXERTS A TREMENDOUS PRESSURE

the base in upright positions. The next step was to portray the scene as shown in the picture. A set of old Christmas toys was procured and reconditioned. The only objects purchased, and these at a cost of seventy-five cents, were the horses for the foreground and the trees for the background. All pieces were then firmly glued in their proper places to the base. The most difficult task was mounting the horses to the plywood. Because of the small surface for gluing, the animals continually toppled over, making it necessary for each one to be held to the base until the "Iron Glue" became set. A small typewritten label, giving the historical background of the experiment, was pasted in front of the ball. This completed the work. The activity was carried on in the home during their leisure time. A saw, hammer, and screw driver were the only tools used.

The finished scene depicts an equal number of horses hitched to each iron hemisphere of a vacuum ball. Directly behind are the nobility and the common people.

History tells us that this "famous experiment" was performed in 1654 before Ferdinand III, Emperor of the Holy Roman Empire. After Guericke had exhausted the air from the ball, the horses were unable to separate the hemispheres because air had exerted a tremendous pressure on their surfaces.

This work has been exhibited at the North Jersey Sectional Conference of the State Science Teachers' Association and in our school library. At the later display, it received second award.

After completing their first scientific project, although at first sceptical of their abilities, the boys found they had gained much confidence in themselves, and at the same time had learned many essentials of good construction.

The writer hopes that this project may be applicable in other schools where the science teacher is looking for ways to create interest and at the same time translate this interest into real educational achievement.

MAITLAND P. SIMMONS,
Irvington High School,
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Digests of Unpublished Investigations

HEALTH MISCONCEPTIONS OF SEVENTH-, TENTH-, AND TWELFTH-GRADE STUDENTS

E. BENTON SALT *

Problem.—"To ascertain the relative prevalence of certain health misconceptions [1] and superstitions as subscribed to by students in the seventh, tenth, and twelfth grades of Florida public schools; to make pertinent comparisons on the basis of sex, grade, race, type of home community, [and] geographical location; and to discover whether there is any relationship between health knowledge and socio-economic status on the one hand and belief in health misconceptions on the other."

Method.—A preliminary Health-information Test of 300 true-false items was constructed from materials secured from five sources: (1) "earlier studies of folk-lore, unfounded beliefs, health misconceptions and superstitions"; (2) "books, articles, and compilations dealing with folk-lore, popular errors, healing magic, omens, nostrums, faith healing, superstitions, medical delusions, misconceptions, and pseudo-medicine"; (3) "press, magazine, radio, and other forms of advertising which contained unfounded health ideas, either stated or implied"; (4) "a list of health misconceptions and superstitions compiled by certain public health nurses in Florida"; and (5) "contributions from various students, teachers, and doctors." This preliminary test was administered in the fall of 1935 to a representative group of 653 pupils of the seventh, tenth, and twelfth grades in public schools of Florida. It was submitted, also, to six physicians, who validated the test items and commented upon such statements as they thought were debatable or ambiguous.

For the final test, 118 false and 32 true items were selected. In the process of selecting these items, all statements in the preliminary test marked correctly by 95 per cent or more, and all marked incorrectly by 95 per cent or more of the trial test group were eliminated. Certain other items were also eliminated because they presented vocabulary difficulty or because of other reasons. One hundred fifty items were retained as valuable items in accordance with the criterion that "a very valuable item is one that is passed only by those whose total scores are considerably higher than the total scores of those who fail that same item."

The 150 items of the final test were grouped in these subject-matter divisions: "Mental Health," "Oral Hygiene," "Food and Nutrition," "Physical Activity," "Organic Function and Disturbance," "Contagions and Infections," "Preventive Measures," "Remedial Measures," "Safety and First Aid," "Advertised Products," and "Miscellaneous Health Misconceptions."

A sample of the test items together with the summary of correct responses to these items is shown in Table LXXXXIII.

"A questionnaire was provided at the beginning of the test to collect data pertaining to the student's name, age, sex, race, grade, home community, and [the] location of the school." A letter was sen to 52 principals of junior-senior high schools in all parts of Florida inviting their co-operation. Thirty-two of these principals signified their willingness to help.

Responses to the test were accordingly secured from 3,221 pupils in the seventh, tenth and twelfth grades in 26 schools for white pupils, and from 592 pupils of these same grades in six schools for Negro children. To determine whether the white pupils responding constituted a representative sampling, the responses of the seventh-, tenth-, and twelfth-grade pupils in two groups of respectively 1,022 and 997 pupils selected at random, were compared with respect to their critical ratios (differences in means divided by S.E.'s of these respective differences). The resulting quotients were all less than 3.0; hence the pupils in each grade were assumed to be representative.

* Unpublished dissertation for the degree of Doctor of Education, New York University, 1936.

[1] Misconceptions and superstitions may properly be designated as unfounded beliefs, a category which "includes all beliefs or ideas that have no scientific basis or support by facts," and that are "further characterized" by having "a causal relationship . . . implied between objects, phenomena, or events where such relationship . . . implied between objects, phenomena, or events where such relationship does not exist." "Misconceptions and superstitions are alike in that they lack scientific support; however, a misconception arises as the result of misinformation, the lack of information, or even unsuccessful attempts to arrive at a rational explanation." A superstition may be considered to embody "an element of fear, faith, or the supernatural."

TABLE LXXXXIII

HEALTH INFORMATION TEST ITEMS RANKED IN DESCENDING ORDER ACCORDING TO THE PERCENTAGE OF NINE HUNDRED EIGHTY-NINE SEVENTH-GRADE WHITE STUDENTS MARKING EACH ITEM INCORRECTLY

Rank	Item	Correct response	Per cent responding incorrectly
1	Everyone should engage in deep-breathing exercises daily	F	92
2	Returning canned food to the refrigerator in its original container after it has been partly used will cause tin or lead poisoning	F	89
3	Milk contains all of the essential elements of a good diet and in sufficient quantities to insure good health and normal body development	F	88
4	It is more dangerous to prick one's self with a pin than with a needle	F	86

The reliability of the test computed by the Pearson Product-moment Method and corrected by the Spearman-Brown Prophesy Formula from the responses to odd and even items in a random sampling of 1,009 tests, was found to be .903.

The test scores were compared statistically, on the basis of 37 categories which included grade, sex, type of home community, geographical location, and race.

"To ascertain the relationship between the socio-economic status of a student and the degree to which the student subscribes to certain health misconceptions, the scores made by 638 white students on the Sims Score Card for Socio-economic Status were correlated with scores made by the same students on the Health Information Test." A similar computation was made between the scores of these students on the Sims test and on the Gates-Strang Health-knowledge Test, Form I. The basis for each of these comparisons was obtained from a computation of the critical ratio determined by dividing the difference in means by the S.E. of this difference.

Conclusions.—1. "Unfounded beliefs relating to health are found to be quite prevalent among seventh-, tenth, and twelfth-grade students in the public schools of Florida, and it appears that formal education has failed in a marked degree to eliminate certain health misconceptions from the beliefs of students in these grades."

2. "The tenth-grade white students subscribe to certain health misconceptions in a greater degree than do the twelfth-grade white students," and to a much smaller degree than do the seventh-grade students.

3. "White girls in the seventh, tenth, and twelfth grades subscribe to certain health misconceptions in a greater degree than do white boys in the same grades of Florida public schools."

4. The reactions with respect to certain health misconceptions were approximately the same for seventh-, tenth-, and twelfth-grade students living in rural and in urban communities, and for white students of these three grades living in East Florida and in West Florida.

5. "Seventh-, tenth-, and twelfth-grade Negro students in the public schools of Florida subscribe to certain health misconceptions in a much greater degree than do white students of the same grades."

6. "There is no one type of health misconception characteristic of any seventh-, tenth-, or twelfth-grade group, i.e., boys, girls; urban, rural; East Florida, West Florida; white or Negro groups." Misconceptions relative to "Physical Activity" and "Advertised Products," however, rank consistently first and second in order of prevalence, and those relative to "Contagions and Infections" and to "Mental Health" have consistently the last two ranks.

7. There is "very little relationship between the factual health knowledge" which a white student of the seventh, tenth, and twelfth grade possesses, and "the degree to which the boy or girl subscribes to certain health misconceptions."

8. "In the case of seventh-, tenth-, and twelfth-grade white students, the relationship between the socio-economic status of the student and the degree to which the boy or girl subscribes to certain health misconceptions, is found to be negligible."

AN INVESTIGATION OF ACCOMPLISHMENT IN HIGH-SCHOOL PHYSICS BY MEANS OF DIAGNOSTIC TESTS

LYNN LOUIS RALYA *

Problems.—(1) "To discover through the use of intensive objective tests, designed especially for the purpose, the degree of accomplishment with regard to those specific concepts, facts, principles, laws, and generalizations which are assumed by present-day high-school physics curricula to constitute the specific objectives in the field of *mechanics*;[1] (2) to discover, through the use of the same tests . . . the general level of accomplishment in the topics represented by the separate sub-tests, unit tests, and summary tests; and (3) to suggest in the light of the findings of the investigation means by which the level of student accomplishment may be raised."

Method.—An analysis was made of the five most popular textbooks of high-school physics (three published in 1937, and two in 1929), to determine the topics and the "specific concepts, principles, laws, generalizations, and abilities to be covered within each topic," and to locate sources of possible misunderstandings, misconceptions, and difficulties such as had been indicated by the results of previous diagnostic testing by the investigator in his own classes. Using the results of this analysis, the investigator constructed a battery of 18 unit tests totaling 585 items, which in his judgment covered all the desired points found in the unit on *mechanics*, and which followed the general order of the corresponding points in the texts. These test items were of the short-answer, completion, true-false, multiple-response of two or more choices, and computative types. Many were provided with diagrams. A summary test of 150 items (thirty 5-item multiple-response groups, having an indefinite number of correct responses) was also constructed to measure the degree to which major concepts, principles, laws, and applications had been grasped by the students. A second form of summary test composed of 150 true-false items covering the same materials as the first summary test was also prepared.

The co-operation was secured of teachers of physics in 24 schools in towns chiefly of Wisconsin, varying in population from two thousand to thirty thousand. The number of pupils studying physics in these schools varied from 10 to 75. The unit tests and the summary tests were administered in these schools. In order, moreover, to "see that a reasonable number of schools and a reasonable number of pupils took each test," the co-operation of additional schools was secured "as occasion demanded." The numbers of schools giving the various subtests ranged from six to 11; the summary multiple-response test was administered in 11 schools and the summary true-false test in seven.

The tests were administered by the regular classroom teachers, immediately upon the completion of the work covered by the particular test. The papers were scored by either the teacher or the pupils, who used a key provided by the investigator. The scoring of some of the unit tests was checked by either the pupils or by their teacher. After the papers had been scored and their scoring had been checked, the papers were in many cases discussed in class. The scorings of tests returned to the investigator were rechecked by him *in toto* or by a process of sampling. Tabulations were made of the correct and incorrect responses for each pupil, of the total score of each pupil, and of the percentages of pupils who responded correctly and incorrectly to each item. These percentages were considered indexes of accomplishment in the specific abilities measured. Computations were made of the means, medians, and S.D.'s of the scores. Also the reliabilities of the tests were computed by the chance-halves method.

Findings and Conclusions.— 1. "Achievement was restricted but little," except in a few places, "by failure to know important English units and important metric equivalents."

2. Achievement was considerably restricted by lack of knowledge of methods of converting values from English to metric units and *vice versa*.

3. A considerable number of students did not possess clear concepts of volume and of mass and weight.

4. "Accomplishment was severely restricted by failure to compute correctly the circumference of a circle with a radius and the value of *pi* given . . ."

5. "Low accomplishment was the rule on problems involving the extraction of square root."

6. Direct and inverse variation were not well understood and direct and inverse variation as the square or square root were even less well understood.

7. "Knowledge of the factual was sometimes considerably greater than understanding of the principle behind the factual."

* Unpublished dissertation for the degree of Doctor of Philosophy, University of Wisconsin, 1933. An abstract of this study under the title given here appears in *Phi Bulletin* (Phi Delta Kappa, University of Wisconsin, Madison, Wisconsin), XII (June, 1935), 2–6.

[1] This study was subsequently extended to include also the fields of *heat, electricity, sound,* and *light,* and the results, in mimeographed-bulletin form, were distributed through the Bureau of Educational Research of the University of Wisconsin, to teachers of physics in a large number of Wisconsin high schools.

8. "Success in recognizing a verbal statement as true did not always involve understanding it and the ability to apply it."

9. "Success in reproducing or recalling a formula was sometimes much greater than the success in solving problems . . . by its use" and "was sometimes greater than the understanding of the relationships represented by the formula."

10. "Success in solving problems was sometimes greater than the understanding of the physical principle upon which the intelligent solution depended."

11. Important principles were sometimes not carried from topic to topic in the student's thinking as they might have been and probably should have been to secure continuity and coherence in the understanding of the subject. Notable illustrations of this weakness were in the failure to apply the laws of motion and gravitational attraction to the explanation of why a freely falling body falls as it does, and the failure to apply the principle of work to all types of simple machines.

12. "Accomplishment was sometimes considerably greater on questions which did not involve exactly quantitative knowledge than on these questions concerning the same principle which did. For example, more knew that gravitational attraction becomes less as the distances increases than knew it decreases exactly with the square of the distance."

Editorials and Educational News

THE RESPONSIBILITY OF THE INSTRUCTOR OF SCIENCE TO THE HOME MAKER

All girls and boys and all young women and young men, regardless of race, creed, vocational aspirations, hereditary accumulations or social backgrounds, are potential home makers.

What should science instruction contribute to the lives of such young people?

We are generally agreed that the outcomes of science in general education involving the development of desirable points of view, practice in the method of science through the solution of life problems, and the formulation, as a result of this problem solving of an ever-expanding body of partial principles and principles to expedite the solution of new and somewhat different problems, provide an adequate non-vocational science program. Several organizations of material within the framework of these outcomes could secure intelligent pupil adjustments to varying life problems. I would like to assume, however, that certain content is more suitable than other content for home makers. There are studies available relating to the contribution of science to the home, but it is not my purpose to summarize research here. I wish to discuss the practical problems of living in the home and community relegating the intellectual problems, temporarily at least, to an inferior position.

Limitations of time, mechanical skill, equipment, and interest make the solution of many problems by the non-specialist difficult. Much of the necessary data and many of the simpler specific techniques can be made a part of their experience in science. When we disregard questions like "Whence comes life?" or "Is the Universe expanding?" science may become a "doing" as well as a "thinking" process. What are some of the problems of "doing" that have especial reference to home makers?

Problems of doing are often suggested by verbs that involve action, e. g. select, care for, and use.

Two studies of home makers list food, mates, clothing, plants, pets, and construction materials as those items that involve problems of "doing."

Regarding foods a number of questions arise. How do we insure that foods are pure and wholesome? This problem involves both the regulation of handling, preparation and serving, and the recognition of inferior foods and food products.

How do we select foods to meet bodily needs? In this problem such requirements as energy giving, tissue building, vitamins, balanced diets, varied diets and minerals are involved.

How do we go about the preparation of foods to make them appetizing and digestible? Such elements as the governing of temperatures, retention of natural flavors, change of physical texture, change of chemical nature, and use of sensory stimulation all make for foods that are appetizing and digestible.

Conservation of foods brings with it such problems as protection from rodents and insects, use of refrigerators, preservation, use of dry ice, pasteurization, and proper storage conditions.

The selection of manufactured and processed food products including dairy, cereal, fruit, meat, and vegetable products is an important and continuing problem. Are certain brands superior to others? Who says they are, and why?

Having applied the verbs of doing to the foods we use, clothing, plants, pets, light, and other areas of common human experience can be treated in a similar manner.

Such science may be described by some

as consumer science, but, if so, it must be participating and not descriptive alone. Specifications for everything from Federal highways to linen handkerchiefs may be secured from reliable sources. There is an abundance of material available in the publications of the government, in *Consumer's Research* or Consumer's Union reports, and in the industrial and trade journals. Manufacturers will provide your laboratories with exhibits of everything from automobile motors to needles.

Science instruction can and should make home makers specification conscious. Here are a few simple everyday problems. Can you solve them quickly?

Should I wear polaroid glasses when driving?

How can I destroy the insects in my garden?

What are the points of comparison used by experts in testing silk hose?

These and hundreds of others like them are in the focus of everyday living. An attack upon those close to the individual can serve as a "springboard" to others until the pupil has become increasingly aware of the march of science in those areas real to him. Such an awareness on the part of the girls and boys may lead to a re-evaluation of the materials for living and to happier home makers.

MARTIN L. ROBERTSON,
Assistant Professor of Education
New York University

SIXTH ANNUAL MEETING OF THE AMERICAN SCIENCE TEACHERS ASSOCIATION

Associated with The American Association for the Advancement of Science

Richmond, December 28 and 29, 1938

Officers

President—Harry A. Carpenter, Rochester Schools, 501 Genesee St., Rochester, N. Y.

1st Vice-President—W. L. Eikenberry, State Teachers College, Trenton, N. J.

2nd Vice-President—James E. Brock, Wayne State Teachers College, Wayne, Neb.

Secretary—Harry A. Cunningham, Kent State University, Kent, O.

Treasurer—Homer W. LeSourd, Milton Academy, Milton, Mass.

PROGRAM

Board of Directors—Wednesday, December 28, 6:30 P.M., Dinner and Conference, John Marshall Hotel.

Morning Session—Thursday, December 29, 9:30 A.M., Auditorium, John Marshall Hotel.

Presiding—W. L. Eikenberry, State Teachers College, Trenton, N. J.

9:30–10:15—Plant Organ and Tissue Physiology as Exemplified in Growing Isolated Roots, Philip R. White, Rockefeller Institute for Medical Research, Princeton, N. J.

10:20–11:05—The Bottom of the Ocean, Charles S. Piggot, Geophysical Laboratory, Carnegie Institution of Washington.

11:10–12 M.—Recent Solar Activity and Allied Phenomena, Dr. Harlan Stetson, Massachusetts Institute of Technology.

Luncheon Meeting—Thursday, December 29, 12:30 P.M., Dining Room, John Marshall Hotel.

Presiding—Otis W. Caldwell, General Secretary, American Association for the Advancement of Science, Yonkers, N. Y.

Speaker—Wesley C. Mitchell, President of the American Association for the Advancement of Science.

Afternoon Session—Thursday, December 29, 2:00 P.M., Auditorium, John Marshall Hotel.

Presiding—Harry A. Carpenter, Rochester Schools, Rochester, N. Y.

2:00–2:15—Announcements.

2:20–2:50—The Science Workbook, Its Use and Abuse, Jerome Isenbarger, Wright Junior College, Chicago, Ill.
Discussion.

2:55–3:25—The Trend Toward Generalized Science in Grades 12 and 13, Hanor A. Webb, Chairman, Division of Science and Mathematics, Geo. Peabody College for Teachers, Nashville, Tenn.
Discussion.

3:30–4:00—Junior Academies of Science, Karl F. Oerlein, Head of Science Department, State Teachers College, California, Pa.
Discussion.

4:05–5:00—Business Meeting. Reports of committees. Election of officers.

Board of Directors—Thursday, December 29, 7:00 P.M., John Marshall Hotel.

MEETING OF MATHEMATICS TEACHERS

The National Council of Teachers of Mathematics will hold its fifth December meeting with the American Association for the Advancement of Science, December 29 and 30 at Williamsburg, Virginia. The following is a skeleton outline of the three programs with the names of the speakers. The general theme is, "Mathematics That Function."

1. Joint Dinner with M. A. A. and A. M. S., December 29, 6:30 p.m.
2. Arithmetic Section, December 30, 9:30 a.m.: R. L. Morton, T. G. Foran, H. E. Benz, B. R. Buckingham.
3. Secondary Mathematics Section, December 30, 9:30 a.m.: H. C. Christofferson, Herbert ReBarker, M. L. Hartung, K. P. Williams.
4. Teacher Training Section, December 30, 2:00 p.m.: F. L. Wren, A. J. Kempner, A. A. Bennett, R. L. Morton.

Reservations at a nominal price in the dormitories at William and Mary College in beautiful and historic Williamsburg. For complete details see *The Mathematics Teacher* for November or December.

FIFTH INTERNATIONAL CONGRESS FOR THE UNITY OF SCIENCE

HARVARD UNIVERSITY, SEPTEMBER 5–10, 1939

PRELIMINARY ANNOUNCEMENT

The Fifth International Congress for the Unity of Science is to be held at Harvard University, September 5–10, 1939.

The theme of the Congress is *Logic of Science*. Interest will center upon the relation of the concepts, laws, and methods of the various sciences. Attention will be devoted to general problems connected with the unification of science, and, in particular, with the logic of the physical sciences, the relation of the physical and biological sciences, and the relation of the biological and sociohumanistic sciences. There will also be a number of special sessions and symposia concerned with special problems and fields.

The International Organizing Committee is composed of R. Carnap, P. Frank, J. Joergensen, C. W. Morris, O. Neurath, H. Reichenbach, L. Rougier, L. S. Stebbing. The American Organizing Committee contains E. T. Bell, P. W. Bridgman, R. Carnap, A. Church, M. Cohen, J. Dewey, H. Feigl, L. J. Henderson, C. J. Herrick, E. V. Huntington, H. S. Jennings, W. Köhler, S. K. Langer, C. H. Langford, K. S. Lashley, V. F. Lenzen, C. I. Lewis, R. S. Lillie, A. O. Lovejoy, R. M. MacIver, W. M. Malisoff, W. P. Montague, C. W. Morris, E. Nagel, F. S. C. Northrop, W. V. Quine, H. Reichenbach, E. Sapir, G. Sarton, H. Schultz, E. C. Tolman, W. Weaver, L. Wirth.

Professor P. W. Bridgman is the Chairman, and Dr. W. V. Quine is Secretary, of the Committee on Arrangements at Harvard University. The Congress is sponsored by the International Committee of the Congresses for the Unity of Science, the International Institute for the Unity of Science, and, in America, by the American Association for the Advancement of Science, the Philosophy of Science Association, the Association for Symbolic Logic, and the American Philosophical Association.

A series of twenty monographs, entitled *Foundations of the Unity of Science* (and constituting the first two volumes of the *International Encyclopedia of Unified Science*) is now being issued by the University of Chicago Press, and helps to provide a background for the Congress. Three monographs have already appeared, and it is hoped that all twenty will be in print by the opening of the Congress.

Those requesting later notices of the Congress are asked to send their names and addresses to Professor Charles W. Morris, University of Chicago, Chicago, Illinois.

Abstracts

SCIENCE

Anonymous. "The Biggest Thing on Earth." *Popular Mechanics Magazine* 69: 489–498, 128A–130A; April, 1938.

The Grand Coulee dam in Washington State, will be three times the size of Boulder Dam, developing 1½ times as much power, and irrigating an area 1½ times the size of Rhode Island. Interesting comparisons are made to make meaningful the hugeness of this project. A good diagram gives the cross-section to scale of five of the world's largest dams. The pictures and descriptions of how this dam is constructed are excellent. —O. E. Underhill.

Anonymous. "Flying the China Clippers." *Popular Mechanics Magazine* 69: 500–503, 118A–120A; April, 1938.

This will furnish interesting motivating material to arouse interest in those phases of astronomical geography dealing with navigation. Dead reckoning, celestial observation, radio bearings all play their part. —O. E. Underhill.

Symposium. "The Chemistry and Physics of Shelter." *Science Leaflet* 10: 6–26; January 21, 1937.

This is an interesting discussion on the ways science is being used in the improvement of the modern home—the development of new building materials and the testing of these under actual conditions of use. —C.M.P.

Mack, Warren B. "Biology of Resemblance and Difference." *Science Leaflet* 10: 30–34, 26–32; March 18 and March 25, 1937.

In the first of these two articles the author discusses the basis of resemblance and difference and in the second article the transmission of resemblance and difference. —C.M.P.

Mack, Warren B. "Biology of Distribution." *Science Leaflet* 10: 31–35, 34–39; April 1 and April 15, 1937.

In the first article the author discusses the factors of the physical environment and in the second article the factors of the biological environment. —C.M.P.

Welch, George B. "Color." *Science Leaflet* 10: 20–25; March 25, 1937.

This is an interesting discussion of the theory of color and its applications. The author is professor of physics in Northeastern University. —C.M.P.

Symposium. "Copper." *Science Leaflet* 10: 3–21; March 4, 1937.

This splendid illustrated article on copper, its metallurgy, and uses as a pure metal, in alloys and in compounds. —C.M.P.

Symposium. "Iron and Steel." *Science Leaflet* 10: 3–24; April 1, 1937.

This is an excellent article on the metallurgical processes of manufacturing iron and steel. Phases discussed include: location of iron ore fields, kinds of iron ores, pig iron, wrought iron, steel, Bessemer process, open hearth process, ingot blooming mill, sheet bar mill, sheet rolling mill, annealing, galvanizing, and electric steel. —C.M.P.

Newman, Barclay Moon. "Can Man Create Life?" *Scientific American* 158: 219–221; April, 1938.

The study of viruses as they relate to life and their possible origin has taken on new significance because of recent studies. The former sharp lines of demarcation between living and non-living melt away as viruses are studied. Viruses seemingly constitute the simplest unit yet studied. This is an excellent article on viruses and enzymes. —C.M.P.

Hall, Lois M. "Infections." *Hygeia* 16: 225–227; March, 1938.

The author illustrates his discussion of the treatment of infections in common cuts or abrasions of the skin by the case of the cut in Mary Jane's thumb. When salve, the standard remedy in her home, seemed not to be the right treatment, the school nurse and family physician took over the task of caring for the infected wound. The treatment described is appropriate for taking care of common breaks in the skin, in preventing infection, and in treating infected wounds. —F.G.B.

Fishbein, Morris. "Modern Medical Charlatans, II." *Hygeia* 16: 113–115, 172, 182; February, 1938.

This article points out that in every field of science charlatans are promoting this scheme and that for their own purposes with little or no regard for truth. There are the widely publicized notions of one who "has a diet for practically every ailment to which modern flesh is heir." There is another system of dieting promoted by a food faddist who has gained considerable notoriety through his writings and his many dietary recipes for health and means of escaping "the evils of neurasthenia, fatigue, fears, bodily distress and depression." There is the strange "exploitation of vitamins" in which are advertised not only established vitamins but also one, the existence of which scientific investigations do not recognize.

The author urges people to be critical in their reading and to place reliance on those who are scientifically trained, who are legally licensed,

and who have experience in diagnosing and in treating disease. —F.G.B.

FYLER, HARRIET MORGAN. "The A B C's of Asparagus." *Hygeia* 16: 339–341; April, 1938.

The author gives a short history of asparagus as a food plant. She says that while it is grown in all parts of the United States, more than fifty percent used for canning and marketing is grown in California. She considers the harvesting, method of grading, and preparation for use on the table. A number of recipes for cooking asparagus are included. —F.G.B.

WORMLEY, LOWELL C. "The Common Cold." *Hygeia* 16: 15–17; January, 1938.

In this article the author discusses the common cold, the sickness that incapacitates more persons during March and October than any other disease. Because of the serious consequences that frequently result from colds, he advises immediate attention as soon as the first symptoms are recognized. To aid in understanding and combating this illness the following points are considered: the nature and causes of colds; important factors in combating colds; treatment of colds; what to do to prevent them; and precautions to avoid giving colds to other people. —F.G.B.

Symposium. "Iron and Steel." *The Science Leaflet* 11: 2–18; March 31, 1938.

This is a rather complete article on the deposition, sources, mining, metallurgy and uses of iron. About 90 per cent of all steel is made in open hearth furnaces. —C.C.P.

Symposium. "Youth and Old Age." *The Science Leaflet* 11: 30–34, 29–30; March 24 and 31, 1938.

The following causes of disease are discussed: (1) Hereditary influences, (2) Improper environment, (3) Injuries, (4) Parasites. Food and longevity are also discussed. —C.M.P.

CHRISTOS, THEODORE. "A Box of Candy from a Peck of Corn." *Science Leaflet* 11: 26–28; May 5, 1938.

This brief article traces the manufacture of candy from its original source—the glucose of the corn grain. —C.M.P.

MYERS, LAURA M. "Standardization of Patterns and Sizes." *The Science Leaflet* 11: 29–35; April 7, 1938.

This article reports on investigations relative to standards in patterns and sizes in women's wear and the need for standardization of patterns and sizes in men's, women's and children's wear. —C.M.P.

SCHECHTER, VICTOR. "A Brief Review of Death." *The Teaching Biologist* 7: 97–101; April, 1938.

"Death is the most characteristic of all of the manifestations of life, in that only that which is alive can die" so says the writer. Universal as death is, it seems impossible to find a case due to "natural" causes. Calcium seems to be definitely associated with death. —C.M.P.

ANONYMOUS. "How Medical Experts Administer Modern Anesthetics." *Popular Science Monthly* 132: 40–42; April, 1938.

This is largely a series of ten photographs with explaining captions. —C.M.P.

ANONYMOUS. "Continents Did Not Drift, Fossil Evidence Shows." *Science News Letter* 33: 328; May 21, 1938.

Dr. Charles L. Camp, geologist of the University of California, concludes from assembled evidence obtained from fossils that animal migration was from the north and not by southern seas. —C.M.P.

ANONYMOUS. "New Star May Be Nearest or Next Nearest to the Earth." *Science News Letter* 33: 327; May 21, 1938.

The Yerkes Observatory reports the discovery of a twelfth magnitude star that has been determined tentatively as 3.7 light years, slightly closer than Alpha Centauri which is 4.1 light years away. —C.M.P.

ANONYMOUS. "New Red Pigment of Liver is Giant of Body's Chemicals." *Science News Letter* 33: 327; May 21, 1938.

Recent research at Yale University has revealed a new red pigment in the liver having the largest molecules yet discovered in the body—probably fifty times the molecular weight of hemoglobin. This would give a molecular weight of between three and four million. —C.M.P.

PEARL, RAYMOND. "Tobacco Smoking and Longevity." *Science* 87: 216–217; March 4, 1938.

This study is based on 2,094 non-users of tobacco; 2,814 moderate smokers; and 1,905 heavy smokers. The men represented an unselected lot except as to their tobacco habits. Smoking of tobacco is statistically associated with an impairment of life duration, and the amount or degree of impairment increased as the habitual amount of smoking increased. Yes, non-smokers live longer than users of tobacco. —C.M.P.

EIFERT, VIRGINIA S. "The Story of Spices." *Natural History* 41: 214–222; March, 1938.

This is an excellent article tracing the story of spices from the earliest known beginnings down to the present—a history that has led to some of the world's greatest discoveries and to unparalleled cultural progress. The first known spices were cassia, ginger and pepper, all of which grew in China. Cloves and anise came from India. Cinnamon was known in China in 2700 B.C. Garlic was eaten by laborers who built the pyramids, and later was used as a remedy for leprosy. During the World War garlic was used as an antiseptic for festering wounds. Nutmeg was used as a fumigant in the streets of Rome. Cloves which Magellan's ships brought

back were sold for more than the entire cost of the three-year expedition. Chocolate and vanilla are New World contributions. —C.M.P.

SCHLAIKJER, ERICH M. "The Living Dead." *Natural History* 41: 203–211; March, 1938.

The living dead are living primitive animals that have changed but little since their first appearance on earth. These animals should have died out as did their ancestors millions of years back in geologic time, but instead have somehow managed to survive down to the present. The rarest, least known, and most primitive primate known is Ptilocercus found in Borneo, Sumatra, and the Malay Peninsula. This primate is probably our earliest ancestor, and more nearly resembles a feather-tailed rat than any other creature. It is about half a foot long and lives on insects and cockroaches. There is an excellent chart showing "Man's Living Ancestor"—how we are closely related to a rat-like patriarch living today. —C.M.P.

BROWN, BARNUM. "The Mystery Dinosaur." *Natural History* 41: 190–202, 235; March, 1938.

This article describes the work in Wyoming and Colorado of the American Museum—Sinclair Expedition of 1937. Failing in its original purpose, nevertheless, the expedition was highly successful. It did discover and recover from the Red Mountain Coal mine in western Colorado the largest dinosaur tracks ever found. This giant had a fifteen-foot stride and individual footprints measuring 34 inches in width and length. It is estimated that this giant towered to a height of about 35 feet. Unfortunately, the expedition did not find the fossil bones it was seeking. Another important discovery was that of the Sabal Palm Leaf, probably the most perfect fossil of its kind ever recovered. —C.M.P.

IVES, RONALD L. "Pictures Through a Pipe." *Science News Letter* 33: 170–172; March 12, 1938.

This article describes a coaxial cable only seven-eighths of an inch in diameter that will carry a television image or 240 telephone messages or 2,880 telegrams simultaneously with less loss of quality than any other cable yet designed. Currents in coaxial cables travel on the surface of the wire, unlike the currnt in lamp cord. The development of this cable brings television nearer, but at that it may still be a long way off. —C.M.P.

ANONYMOUS. "Parts of Brain Removed, Intelligence Not Affected." *Science News Letter* 33: 230; April 9, 1938.

Large portions of the important frontal lobes of the brain can be removed surgically without apparent damage to the intelligence. Four test cases showed no impairment of intelligence. —C.M.P.

ANONYMOUS. "Million-Miles Prominence Rises from Sun's Surface." *Science News Letter* 33: 233; April 9, 1938.

Mt. Wilson Observatory scientists on March 20 observed the highest solar prominence ever measured. It reached a height of 970,000 miles and was still rising when clouds interfered with further observations. The greatest prominence hitherto observed was one of 621,000 miles on September 17, 1937. —C.M.P.

DAVIS, NATALIE HARLAN. "Flowers as National Emblems." *Natural History* 41: 275–281; April, 1938.

This is an illustrated article, with brief descriptions, of the national flowers of various countries. The United States is not included because there exists no national unity on the choice of a flower. The national flower of England is the rose; Scotland, the thistle; Ireland, the shamrock; Wales, the leek; United Kingdom, the thistle, rose and shamrock; India, the lotus; Canada, the maple leaf; Egypt, the lotus; France, the fleur-de-lis; Japan, the chrysanthemum; Turkey, the tulip; Spain, the pomegranate; and Persia, the rose. —C.M.P.

EMMONS 3RD., ARTHUR B. "The Highest Mountain Ever Climbed." *Natural History* 41: 245–264, 313; April, 1938.

This is a description of British-American Himalayan Expedition that successfully climbed Nanda Devi which had frustrated the ablest mountaineers for more than fifty years. The climb to the height of 25,645 feet was completed on August 29, 1937. —C.M.P.

RUSSELL, HENRY NORRIS. "The Odd New-Old Star." *Scientific American* 158: 206–207; April, 1938.

This article gives the astrophysical interpretation of the recently much-talked-of huge star in Auriga near Capella. This star has been known for a long time and is visible to the naked eye. Recent studies show it to be an eclipsing binary. The interesting thing is the huge size of the large star—about 3,100 times the diameter of the sun. This dwarfs in size the largest star previously measured—450 times the diameter of the sun. —C.M.P.

EVE, A. S. "Northern Lights." *Scientific American* 158: 216–218; April, 1938.

The three main forms of displays are the arc or arch, the curtains, and the long streamers. Streamers often take on a drapery appearance. The color is commonly greenish white or greenish yellow, sometimes with an admixture of red or violet. The altitude of the aurora is commonly about 60 miles from the earth, the record height for the top of a streamer being more than 600 miles. Results of research on the aurora may aid in the solution of many other atmospheric problems. Sunspot activity seems to be closely associated with the aurora. —C.M.P.

VINTON, KENNETH W. "A Frog That Eats Bats and Snakes." *The National Geographic Magazine* 73: 656–664; May, 1938.

This article describes one of the most unusual frogs known to science. This one lived in the Panama Canal Zone. Its appetite and strength are extraordinary. —C.M.P.

BARTON, JR., WM. H. "Sun-Spots in the News." *Natural History* 41: 344–350; May, 1938.

This article discusses the possible effects of sun-spots on climate, crops, health, the stock market, and northern lights. It is thought that sun-spot activity will reach its maximum this year or early 1938, if the maximum has not already been reached. Illustrated. —C.M.P.

MONTGOMERY, FRANK H. "Starch from the Sweet Potato." *Scientific American* 158: 280–281; May, 1938.

A sweet potato starch factory has been developed at Laurel, Mississippi, for the production of starch. The success of this plant promises to be the forerunner of the development of an industry of vast economic importance. The old problem of yellow color in the starch has been solved by bleaching with sulfur dioxide and treatment with sodium hydroxide. The capacity of this new factory is 200,000 bushels of sweet potatoes per 100-day season, producing about two million pounds of starch, all of which is now used in textile manufacturing. It is estimated we could use 150 such plants, if our needs for root starch are fully met. —C.M.P.

CRIDER, JOHN H. "Unpuzzling Color." *Scientific American* 158: 284–285; May, 1938.

This article describes a color system that is being developed to bring about definite standards in color because present color names cause so much confusion. It is said that the new system has the advantage of being workable by anyone with good eyesight. Basic colors are: red, yellow, green, blue, purple, white, black, and grey. Component hues are: pink, orange, olive, and brown. Modifiers are: pale, brilliant, vivid, faint, dusky, deep, light, dark, weak, and strong. The adverb "very" is also used as is the ending "ish" as a modifier of definite names such as "reddish purple." —C.M.P.

LEFEBVRE, R. NEUMANN. "Green Gold." *Natural History* 41: 325–343, 393; May, 1938.

The term Green Gold refers to the forests, and this article is a plea for their conservation and the need for reforestation. Between 1926 and 1930 the average annual burn in the United States was 41,538,000 acres, destroying nearly 900 million cubic feet of timber. At the same time about 985 million cubic feet were destroyed by disease, insects, drought, wind, etc. There are a series of excellent photographs. —C.M.P.

MANN, WILLIAM M. "Monkey Folk." *The National Geographic Magazine* 73: 615–655; May, 1938.

The National Geographic presents in this issue the first series of full-color illustrations of monkeys yet to appear in any periodical. There are 24 illustrations and 40 portraits in color from life. —C.M.P.

FRENCH, SIDNEY J. "Personalities of the Elements." *Scientific American* 158: 340–342; June, 1938.

This article explains in terms of fundamentals the reason why the diamond and silicon carbide is so hard, why neon is inert, why copper is soft and so on. The diagrammatic representation of the conduction of electricity by a metal is interesting. —C.M.P.

HARDING, T. SWANN. "But Can You Eat Onions?" *Scientific American* 158: 330–332; June, 1938.

Scientific studies are being made to determine what foods do not agree with people. A study by Dr. Walter C. Alvarez of the Mayo Clinic found the following foods (listed in descending order of frequency) to produce more or less distress in 10 to 28 percent of 500 persons questioned: Onions; milk, cream or icecream; raw apples; cooked cabbage; chocolate; radishes; tomatoes; cucumbers; eggs; fats, greasy and rich foods; cantaloup; meat or beef; strawberries and coffee. Among foods very seldom offending are: lamb, gelatine, butter, sugar, rice, carrots, asparagus, turnips, beets, squash, and canned pears. —C.M.P.

MANN, WILLIAM M., AND LUCILE Q. "Around the World for Animals." *The National Geographic Magazine* 73: 665–714; June, 1938.

This is a resumé of a nine months' animal-collecting expedition around the world under the auspices of the National Geographic Society and the Smithsonian Institution. Many photographs add to the interest and the attractiveness of the article. —C.M.P.

New Publications

MEIER, W. H. D., AND SHOEMAKER, LOIS MEIER, *Essentials of Biology*. Boston: Ginn and Company, 1938. 700 p. $1.80.

This is an enlarged edition of a text already well known to teachers of high school biology. The experience of the authors, both in the field of biology and as teachers, is guarantee of a sound, well organized text. Following the general practice of presenting type forms, it has amplified the material by the introduction of additional related living forms. It seems to the reviewer that Unit III, The Relation of Animal Organisms to Their Environment, hardly realizes the possibilities of its title by confining itself to five chapters on insects and a sixth dealing with the other arthropods, none of which stress particularly the ecological phases.

—O. E. Underhill

MOULTON, FOREST RAY (editor). *The World and Man as Science Sees Them.* Chicago: The University of Chicago Press, 1937. 533 p. $3.00.

A little more than a decade ago Dr. Newman and other well-known scientists at the University of Chicago published *The Nature of the World and Man,* a text which introduced a new type of orientation course in science for colleges. The present volume, a noteworthy successor to that earlier successful book, has been written by thirteen eminent scientists, including Dr. Newman and present or former members of the Chicago faculty. Its contents show an excellent degree of uniformity and are rather evenly divided among the separate sciences of astronomy, geology, physics, chemistry, biology, botany, zoölogy, paleontology, physiology, and anthropology.

Chapter headings and authors are as follows: "Astronomy," Forest Ray Moulton; "The Origin and History of the Earth," Rollin T. Chamberlain; "Particles and Waves," Harvey Brace Lemon and Reginald J. Stephenson; "Chemical Processes," Hermann I. Schlesinger and Eugene J. Rosenbaum; "The Nature and Origin of Life," Horatio Hackett Newman; "The Problems of Life and Reproduction in the Plant Kingdom," Merle C. Coulter; "Evolution and Behavior of the Invertebrates," W. C. Allee; "Vertebrates," Alfred S. Romer; "Physiological Processes," Anton J. Carlson; "Microörganisms and Their Roles in Nature," William H. Taliaferro; "Man," Fay-Cooper Cole. —C. E. Baer.

SKINNER, H. CLAY, SMYTH, THOMAS, AND WHEAT, FRANK M. *Textbook in Educational Biology*. New York: American Book Company, 1937. 472 p. $2.50.

This volume is an introductory course in biology designed for teachers colleges. The authors have made a careful selection of the major principles of biology that are recognized as of greatest value in the educational foundation of teachers in training. The text is built around six units, each subdivided into appropriate problems: (1) Living plants and animals are composed of one or more units called cells, and all start from pre-existing parent forms; (2) The millions of plants and animals can be arranged into orderly groups of varied associations and relationships; (3) Plants and animals both serve and hinder the progress and welfare of man; (4) The human body needs food materials to maintain its normal active condition of health; (5) Living things that make correct adjustments to the environment survive and preserve their kind; (6) The chain of life has been forged of links of varied design. At the end of each unit there is a three-page objective test.

Excellent photographs, pen drawings and charts appear throughout the book. The reviewer is impressed with both the quality of the illustrations and the completeness of the legends. Questions, somewhat brief topics for investigation, and suggestions for laboratory work follow each problem within the unit. The addition of page references in the bibliography and diacritical marks in the glossary would aid the beginner. The work on vitamins is a digest of up-to-the-minute summary of research compiled by the Protein and Nutrition Division of the Bureau of Chemistry and Soils, Washington, D. C.

The book is highly recommended for use in teacher training institutions. —C. E. Baer.

NEEDHAM, JAMES G. *A Survey Course in General Biology*. Ithaca: The Comstock Publishing Company. 366 p. $2.20.

This is a short general course for students not planning to specialize in biology. However, the technical terminology, while cleverly introduced so as not to block the progress of the general reader, is there so the text would serve adequately for an introduction to further work in this field. The first four chapters, comprising nearly half the text, give a general introduction to plant and animal structure, emphasizing evolutionary development from simple to complex forms. The remaining eight chapters are an exceptionally fine presentation of the great interpretive principles of biology. —O. E. Underhill.

FITZPATRICK, FREDERICK L. *Tests in Biology*. Boston: Houghton Mifflin Company, 1937. $0.40.

Objective tests of the diagnostic and achievement type are provided for each unit represented in the textbook *Biology* by Fitzpatrick and Horton. Alternate forms designated as Form A and Form B have been prepared for each of the

seven units. The test items have been well selected and organized into appropriate types, such as multiple-choice, true-false, completion, and matching. The tests have not been standardized.

—C. E. Baer.

WATKINS, RALPH K., AND BEDELL, RALPH C. *Workbook to General Science for Today.* New York: The Macmillan Company, 1937. 144 p. $0.60.

The organization of this workbook parallels exactly that of the textbook. There is a wide variety of activities designed to train in all types of science learning and to provide for individual differences. In addition to the fundamental exercises on each unit there is a list of "Other Things to Do," "Recreational Science Hobbies," and "Your Science Reading." Comprehensive loose-leaf objective tests with keys are provided for each of the fifteen units. —C. E. Baer.

TORGERSON, T. L., RICH, C. L., AND RANNEY, HARRIET. *Torgerson-Rich-Ranney Tests in Physics.* Cincinnati: The C. A. Gregory Company, 1935. Battery of two tests; two forms of each test. $1.02 per test.

Test No. 1 covers mechanics and heat; test No. 2 electricity, and magnetism, heat and sound. The working time for test No. 1 is 95 minutes, and for test No. 2 is 100 minutes. Norms are given for pupils who took each section of each test immediately following the study of that section. —O. E. Underhill.

KANSAS STATE TEACHERS COLLEGE. *Every-Pupil Scholarship Tests.* Emporia, Kansas: Bureau of Educational Tests and Measurements. $0.02 per test.

Each test is forty minutes in length and in two forms. The general science, biology and chemistry tests have a form for each semester. The Fulmer-Schrammel physics test grew out of the "every-pupil" testing program and is in two parts, with two forms for each part. The Williams biology test is in three forty-minute sections, two forms for each section. Part III deals with plant biology only. The authors and tests are as follows:

Gill, Ethan M., and Schrammel, H. E. Gill-Schrammel Physiology Test Forms A and B.
Fulmer, V. G., and Schrammel, H. E. Physics Test 1 Forms A and B; Test 2 Forms A and B.
Simpson, W. E. Test in Biology Forms A and B.
McFarland, Henry J. Test in General Science Forms A and B.
Clapton, D. Test in Chemistry Forms A and B.
Williams, John R. Biology Test 1 Forms A and B; Test 2 Forms A and B; Test 3 Forms A and B.

—O. E. Underhill.

MANCHESTER COLLEGE. *Manchester Semester-End High School Tests.* North Manchester, Indiana: The College. $0.02 per test in lots of 100.

Each test is an eight-page booklet, a separate test for each semester, designed for sixty minutes. The authors and tests are as follows:

Neher, O. W., Freed, Leigh B., and Krom, A. B. First Year Biology Test—First and second semester forms—two each.
Morris, Charles S., Schubert, C. C., Skaar, Carroll, and Shanahan, Joe. Physics—Two forms of second semester tests.
Martin, Don, Schubert, C. C., Black, Roy D., Holl, C. W., and Reber, Paul. High School Chemistry Test.

—O. E. Underhill.

PURDUE UNIVERSITY. *State High School Tests for Indiana.* Lafayette, Indiana: Purdue University, Division of Educational Reference, 1937. $0.02 per test.

These tests are based on Indiana state curricula. They are in mimeographed form, one test for each semester in each subject. Sample test with key will be sent for $0.15, or the complete high school set (includes 31 tests covering all subjects) for $1.50. Cost of samples may be applied on orders. The authors and tests are as follows:

Rifenburgh, S. A. Biology Form A First and Second Semester Tests.
Allen, F. J. Chemistry Form A First Semester.
Shoutz, Geraldine, Donaghy, Fred, and Karpinski, Robert. General Science Test Form A First Semester.
Mackell, James F. Physics First and Second Semester.

—O. E. Underhill.

WELLS, GEORGE (editor). *Comprehensive Objective Tests in High School Subjects.* Oklahoma City, Oklahoma: Harlow Publishing Company.

Each subject is covered by a battery of eight tests. The first six cover the content for each six weeks period, the seventh and eighth tests being semester reviews. Each single test in the battery is a three-fold sheet of six pages. The authors and tests are as follows:

Watson, M. C. Chemistry Tests I–VIII.
Halley, E. E. General Science Tests I–VIII.
Hurst, M. E. Physics Tests I–VIII.
Stemen, T. R., and Myers, W. S. Biology Tests I–VIII.

—O. E. Underhill.

IOWA, UNIVERSITY OF. *The 1938 Iowa Every-Pupil Tests.* Iowa City, Iowa: Bureau of Educational Research Service, Extension Division, University of Iowa.

Each of these tests requires one hour. The pupil detaches the first page and indicates his answers by marking crosses in the proper boxes on this page. A score card which has properly spaced holes punched in it is placed over the answer sheets. The crosses showing through the holes are counted to give the score. The authors and tests are as follows:

Kambly, Paul. Biology.
Schindler, Alvin W. General Science.
Schindler, Alvin W. Physics.
Schindler, Alvin. Chemistry.

—O. E. Underhill.

OHIO STATE DEPARTMENT OF EDUCATION. *Every-Pupil Test.* Columbus, Ohio, 1938. $0.02 per test.

Each test is a single sheet, and is designed to be taken in forty minutes. An attempt is made

in some of these tests to measure ability to apply scientific principles and interpret data. The physics test in particular emphasizes this. On the first page one column of twenty-five items is in terms of "facts and principles." The second column has twenty-two additional items which are based on "applications of principles." These items are grouped under two situations. In answering the items the pupils must select one of three items to indicate what would happen in the situation described, and then other items to indicate why it happens. Part III has three groups of items, each item to be answered in terms of stated data. While these attempts to measure other items than mere memory are desirable, so much space is required to state such questions that a test containing much of this material becomes much less comprehensive. The authors and tests are as follows:

Colblentz, Mary E. Biology.
Hook, Glenn. Physics.
Tucker, Alfred C. Chemistry.
Wray, Florence; Shepherd, Harless; Rector, W. E.; Pees, Merwyn; Silverthorn, Robert, and Ransdell, Frank C. General Scinece.

—O. E. Underhill.

FRANZEN, RAYMOND, DERRYBERRY, MAYHEW AND MCCALL, WILLIAM. *Health Awareness Test.* New York: Bureau of Publications, Teachers College, Columbia University.

In 1929 the American Child Health Association published tests used in research, but requiring an hour and a half to administer. This test is a shorter form made from selected items having the most diagnostic value based on the results of the research program with the longer test form. It require but thirty minutes and may be used with children as young as eight years of age. The first part of the test is a story in which certain parts are underlined or crossed out to indicate their value as health habits. Other parts are matching and true-false. Careful directions with blackboard illustrations are to be given to insure that the pupil understands what he is to do. —O. E. Underhill.

BURT, OLIVE WOOLEY. *Our Magic Growth.* Caldwell, Idaho: Caxton Printers, 1937. 138 p. $2.00.

Using a sort of Alice-in-Wonderland technique, in the form of bed-time stories, Doris and Blaine and their mother are made small enough to attend Perry Paramoecium's party, visit Vera Vorticella, become acquainted with Amoeba Ann, and so on. It seems to the reviewer that the personification and other trappings which dress up the information, presumably in an attempt to make it interesting to children, will be less effective than would a straightforward presentation of the facutal material. —O. E. Underhill.

FITZHUGH, EDWARD F. *Treasures in the Earth.* Caldwell, Idaho: The Caxton Printers, 1936. 130 p. $2.00.

This is an easily read and easily understood book on mining geology coming at a time when the importance of gold and silver is outstanding. There are few technical terms in the book. Faults and rock structures are explained by novel models using half-pound bricks of "Process American" cheese. *Treasures in the Earth,* prepared as popular science for the layman, will make an appeal to student and teacher as well. The first third of the book reviews the major geologic processes. Then, Mr. Fitzhugh vividly describes how the "juices" from the magma pockets escape, concentrate and deposit in ore bodies. He shows how a modern commercial science, using microscopes, models, diamond drills, and electrical apparatus is related to the age-old work of the prospector. Sixteen full-page illustrations of geologic forms and operations add to the fascination of this unusual book. —C E. Baer.

WILLIAMS, JESSE FEIRING. *Personal Hygiene Applied.* Philadelphia: W. B. Saunders Company, 1937. 627 p. $2.50.

In this, the sixth edition of his popular college text, Dr. Williams reaffirms his philosophy of human life, "to live most and to serve best." In bringing it up-to-date he has added a new chapter on the Hygiene of the Endocrine System, has prefaced chapters with a discussion of anatomical and physiological facts, and has included in the appendix a list of term reports and a standardized true-false test.

The text is more than a survey of health facts and their applications; in no other book is the fundamental philosophy of health and hygiene so clearly stated. Every educational philosopher will profit by reading the introductory chapters. Then, follow chapters giving in detail the hygiene of the muscular and skeletal systems, nutrition, respiratory, circulatory, endocrine, execretory and nervous systems, sex, prevention of specific diseases, hygiene of the mouth, eye, and ear.

—C. E. Baer.

ENLOWS, HAROLD F. (editor). *American Red Cross First Aid Textbook.* Philadelphia: P. Blakiston's Son and Co., Inc., 1937. 256 p. $0.60.

First aid treatment is becoming more and more important in this machine age. Realizing this need the members of the American Red Cross First Aid Staff have compiled a compact and up-to-date reference of the latest first aid methods. Replacing the 1933 text this revised edition "has become necessary due to changes in the practice of treatment of injuries now generally adopted by the leading surgeons of the United States. The most important of these changes is the acceptance of the principle of fixed traction in the emergency treatment of fractures of the arm and leg."

Numerous illustrations assist the reader to develop better and surer technique. The reviewer knows of no better handbook for the use of teachers, first aid instructors, scout leaders and laymen. Its use is helping to prevent suffering and loss of life. For the housewife the chapters on

injuries due to heat and cold, poisons, unconsciousness, and common emergencies are valuable.

—C. E. Baer.

LUMLEY, ELLSWORTH D. *Owls.* Unit 5, Teaching Units, Conservation Series, Publication No. 67. New York, 734 Lexington Ave.: Emergency Conservation Committee, 1937. 10 p. $0.10.

Everyone interested in wild life appreciates the work of the Emergency Conservation Committee whose slogan is, "The time to save a species is while it is still common. The way to prevent the extinction of a species is never to let it become rare." This booklet is the fifth of a series prepared for classroom use. It is prefaced by Dr. Paul L. Errington, Iowa State College, one of America's foremost authorities on game management, who says, "Our owls—the 'good' and the 'bad' alike, among other native wild creatures—*belong* to our woods and our prairies, and it is our duty to insist that they as a part of our heritage be administered with reasonable care." Other units of the series are: Unit I—Shortage of Waterfowl, Unit II—Hawks, Unit III—Eagles, Unit IV—Fish-eating Birds.

—C. E. Baer.

BUSH, GEORGE L., PTACEK, THEODORE W., AND KOVATS, JOHN, JR. *Guided Activities in Senior Science.* New York: American Book Company, 1937. 251 p. $0.48.

This workbook, prepared by the authors of *Senior Science,* follows in order the units, water, fire, fuels, weather and air, foods and medicine, textiles, building materials, home equipment, transportation, safety. The study exercises include drawings, charts and tables which are to be completed, explained or organized to suit the demands of the exercise. Experimental investigations and related activities which may easily be carried out at home or in the school laboratory are outlined for use in connection with these exercises. The book is an excellent example of directed study and evaluation of student progress, featuring a complete set of self-testing exercises for each division of the respective units. Your reviewer believes, however, that provision should be made for a list of selected books and pamphlets as encouragement to further reading and investigation.

—C. E. Baer.

BAUGHMAN, IMO P. *Elementary Chemistry with Practical Applications.* Philadelphia: Lea and Febiger, 1937. 296 p. $2.75.

Designed as a textbook for girls taking health and nursing courses in junior college this work presents in condensed form most of the general principles of chemistry used in the home. Many topics ordinarily not given in an elementary text are included. X-rays and radium are used as an introduction to the fundamental nature of matter. Air, water, solutions, acids, bases, salts, catalysts are surveyed. The carbon compounds, food chemistry, body fluids, textiles and detergents are covered in simple and direct style. Throughout the text the author presents a careful selection of facts and principles from the fields of physiology, physics, nutrition, hygiene, sanitation and medicine.

The book is an interesting and understandable approach to applied chemistry. Supplementary reading and laboratory work should parallel the use of the text, but unfortunately no reading references or bibliography are given.

—C. E. Baer.

ADELL, JAMES C., DUNHAM, ORRA OLIVE, AND WELTON, LOUIS E. *Explorations in Biological Science.* Boston: Ginn and Co. 345 p. $1.12.

Based on experience with many thousands of children the author's have selected those experiments which had been found most generally enjoyable for the "problems" and those which had been very much liked by some individuals but not by others as "projects." The projects are sufficient in number and scope to provide for selection, it not being expected that each member of the class will do every project. Each problem provides for oral review of the preceding problem, suggestions for interesting reading, directions for the activity, guiding questions and class discussion. Each unit ends with a page of "student aids" which include extensive page references to commonly used texts, questions and problems which require application of the previous work, and a "self-mastery test" of the completion form, the actual words being written on separate paper. This manual is far more than a mechanical blank-filling workbook. It is a real guide to direct study, and stimulates independent thinking.

—O. E. Underhill.

HANN, C. S., AND STODDARD, MABEL B. *Workbook and Laboratory Manual in Biology.* New York: College Entrance Book Co., Inc., 1937. $0.60.

This follows a more or less standard biology course. Each of the twelve "units" has an "exploration test" of 30 true-false items, page references to about a dozen of the most used high school biology texts, exercises and experiments, and a "self-teaching test" of matching exercises, completion test, or vocabulary exercise. A separate booklet of tests, one for each unit, which may be detached and given separately is provided with each manual. Many of the matching items in both the "self-teaching tests" and in the unit tests seem to the reviewer to be rather poorly designed, in that the items in any one group to be matched are so dissimilar both as to content and English form.

—O. E. Underhill.

FINDLAY, ALEXANDER. *A Hundred Years of Chemistry.* New York: The Macmillan Company, 1937. 352 p. $4.25.

During the past century great advances have been made in our knowledge of matter, and he chemist has played a leading part in that century of progress. The author, professor of chemistry in the University of Aberdeen, traces broadly, yet faithfully, "how chemists have studied the

properties and transformations of matter and have ascertained the laws according to which these transformations take place; how they have unraveled the inner structure of and arrangement of the atoms in the molecules of many of natures most important compounds, and have succeeded in building up these compounds in the laboratory; and how, as the result of great experimental skill and philosophic insight, they have gained ever clearer views of the fundamental nature of matter." Although *A Hundred Years of Chemistry* is mainly a survey of chemical theory, the outstanding applications of chemical science to industry and social beterment are not omitted.

Every professional chemist and student of chemical education will profit by the perspective gained from reading this review of the growth of chemical science.

JONES, J. BYRON, MATHIAS, LOUIS J., JR, AND WEISER, RAYMAN S. *Workbook and Laboratory Manual in Chemistry.* New York: College Entrance Book Co., Inc., 1937. 312 p. $0.96.

The year's work is presented in fifteen "units." Each unit is provided with an introduction, outline, class demonstrations, honor work, textbook exercises, experiments and a review test. The problem exercises have blanks left so that the instructor may dictate his own data thus providing opportunity for variation. A set of unit tests is provided in a separate pamphlet.

—O. E. Underhill.

DAVIS, JEROME F., HUTCHINGS, VERNE U., AND SHARPE, CLARENCE P. *A Directed Study Guide in General Science.* 7th and 8th grade (2 vols.). New York: College Entrance Book Co., Inc. 7th grade—124 p. $0.64. 8th grade—156 p. $0.73.

The 7th grade manual covers water, rocks and soil, air, fire, life. The 8th grade units are the heavens, the weather, water, sanitation, garden, conservation. Page references for each unit are cited to half a dozen of the well known general science texts. A list of suitable films. is given. "Motivation" for each unit consists of four or five questions. Unit tests, mid-year and final examinations and directed study guide are provided in a separate booklet.

—O. E. Underhill.

VAN ALLER, HOLGER H., AND VAN ALLER, DOROTHY. *General Biology Study Book.* New York: Globe Book Company, 1937. 149 p. $1.00.

This is a work book, but in bound form rather than loose-leaf. The student writes out answers to questions of various types on separate paper, thus not requiring the purchase of a new manual each year. Divided into eight units, each is opened with over-view questions, followed by instructions for study and for carrying out various types of activity, check up materials in true-false, multiple choice and completion forms, and so on. The more than thirty experiments are intentionally not set out separately as such, but are woven in with the other study guide materials. Many of the questions and activities are extremely ingeniously devised to stimulate real thinking. Quizz material is published separately as a teacher's supplement. An appendix carrier specimen examination for both semesters of the years 1934-1937 inclusive, presumably the New York State Regents Examinations, although the source is not given. —O. E. Underhill.

STILES, WILLIAM E., NEWMAN, BARCLAY M., AND GLOVER, MYRON H. *Workbook and Laboratory Manual in General Biology.* New York: College Entrance Book Company, Inc., 1936. $0.60.

This manual is based on the course introduced by the New York State Education Department and follows the State syllabus. Review exercises have been adapted from past Regents examination papers. Page references to a dozen or more high school biology texts are cited at the beginning of each unit. —O. E. Underhill.

BUNZELL, H. H., AND NISENSON, SAMUEL. *Everyday Chemistry.* New York: Grosset and Dunlap, 1937. 128 p. $1.25.

This is a very much abbreviated but very concisely written chemistry. It is designed for the general reader who wishes to acquire the fundamental background of elementary chemistry rather than as a text. It presents accurately and with wise selection the absolute minimum of essential information, treating in one or two pages material which is usually given a complete chapter in chemistry texts. Many excellent drawings illustrate the material. The print is rather fine, as much page space is taken up by illustration, making it rather trying to the eye to read. Abstract theory is at a minimum and emphasis is placed on the applications of chemistry to our life and industry. —O. E. Underhill.

WAIT, WALLACE T. *The Science of Human Behavior.* New York: Ronald Press Company. 335 p. $2.75.

This book presents psychology to college freshmen and to laymen as a study of what persons do and why they do it. The author has selected his materials from rather practical areas of normal and of abnormal behavior. He then proceeds to discuss the factors that are known or presumed to produce or modify these behavior patterns. Attention is given to the structure of the human being, his heredity, his development, his drives, and his experience as each is related to behavior. The book closes with two practical chapters relating to the adjustment of the total organism and its final complete integration to form the personality. The book is an entering wedge into an educational area where real need exists. It implies the need for the recognition of the impingement of the anatomical structure and the physiological function of the human body upon its behavior. Due apparently to the level for which the book is written and its size, its treatment of the biological bases of behavior is quite superficial. It seems entirely consistent with the author's purposes, however, to emphasize the ob-

servable results rather than the contributing forces. It is also his purpose to orient rather than to instruct in detail.

At the close of each chapter is an outline summary. It is a device, however, which does not seem compatible with the idea that students should integrate their own experiences and, in the opinion of the reviewer one that is not an asset to any text. The problems for further thought at the end of each chapter are so superior to the usual "questions" as to allow no comparison. There is an adequate list of suggested readings and the book is well illustrated by thirty-six plates and figures. —M. L. Robertson.

CANNON, JAMES L. *Hoofbeats, A Picture Book of Horses.* Chicago: Albert Whitman, 1938. 48 p. $1.50.

A beautifully gotten-up series of fullpage pictures of various types and breeds of horses. Each illustration is accompanied by a brief, interesting story. The types illustrated are the Thoroughbred, Circus Horse, Polo Pony, Indian Pony, Standard Bred, American Saddle Horse, Shetland Pony, Hunter, Hackney, Police Horse, Western Cow Pony, Arabian, Palomino, and Morgan. —O. E. Underhill.

CUSHING, BURTON A. *Laboratory Guide and Workbook.* Boston: Ginn and Company, 1937. 239 p. $0.76.

This is designed to accompany Millikan Gale and Coyle'e Elementary Physics. Some of the exercises are a completion form to be filled in after reading the text. Others are the regular laboratory directions with tables and blanks for recording data, calculations, etc. A set of separate multiple-choice tests, one for each of the seven "units" is included. The reviewer feels that the writer of the preface is somewhat optimistic in feeling that because each experiment is opened with a statement of purpose, followed by listing equipment, procedure, tabulating data, making calculations, and finally stating the results will lead the pupils "to attack his problem by the scientific method." —O. E. Underhill.

CLARKE, FRANCIS E. *Our Animal Books.* Boston: D. C. Heath and Company, 1937.

This series of seven books is for use in kindergarten or pre-school and the first six grades. Their purpose is to motivate an intelligent regard for birds and animals. All books are illustrated in color. The book titles and authors are as follows:

Primer. *Fuzzy Tail,* by Arena Sondergard, is the story of a cat. 134 p. $0.72.
Book 1. *Sniff,* by James Tibbett and Martha Tibbett, tells how to bring up a puppy—the story of a dog. 184 p. $0.80.
Book 2. *Pets and Friends,* by Emma A. Myers, is about lambs, chickens, horses, rabbits, and bears. 186 p. $0.84.
Book 3. *The Pet Club,* by Katharine W. Masters, tells of animals. Used for instruction in the classroom. 223 p. $0.92.
Book 4. *On Charles Clarke's Farm,* by Katharine L. Keelor, relates the experiences of a boy in contact with farm and forest animals. 196 p. $0.72.
Book 5. *Our Town and City Animals,* by Francis E. Clarke and Katharine L. Keelor, tells of animals dwelling in town and city. 280 p. $0.76.
Book 6. *Paths to Conservation,* by James S. Tibbett, emphasizes need of participation in protecting birds and mammals. 299 p. $0.88.

—W.G.W.

CAMPBELL, HEYWORTH. *Camera Around the World.* New York: Robert M. McBride, 1937. 128 p. $3.00.

Oversized pages filled with excellent photographic art selected from thousands of photographs from every corner of the globe. "Camera Around the World is a pictorial world tour . . . we move capriciously across seas and continents in search of the unusual. . . . An attempt to assemble beautiful, exciting, original and dramatic photographs from many parts of the world. . . . An exhilarating panorama of the world seen from many different points of view and portrayed with all the magic of technical skill and creative imagination." —O. E. Underhill.

FLETCHER, GUSTAVE L. *Earth Science.* Boston: D. C. Heath and Company, 1938. 568 p. $2.20.

This revision of a new physical geography by Arey and others brings back to life a high school subject that has been losing ground in recent years. The treatment is well adapted to high school pupils. Many chapters are much improved over those in the older book, not only in style, but in up-to-date material and additions. We are a little disappointed in the treatment of weather. It seems to lack full enough explanations and the latest theories about mass air action. On the whole, however, the book is one of the best of the present day texts covering physical geography. At chapter ends there are tests and exercises for pupil review. It is well illustrated. —W.G.W.

BEATY, B. Y. *Story Pictures of Our Neighbors.* Chicago: Beckley-Cardy Company, 1938. 191 p. $0.80.

This book for second and third grades stresses good social habits, as it relates the daily experiences of two typical young American children. It tells the story of how the community provides food, clothing, shelter, transportation, communication, and recreation. It is illustrated by many fine color plates. —W.G.W.

BRAUER, OSCAR L. *Chemistry and Its Wonders.* New York: American Book Company, 1938. 760 p. $2.00.

This attractive volume owes much of its appeal to its informal appearance. It is not, however, just a "Popular Science" brand of text. It contains the substance required for college entrance and at the same time covers much practical material and treats it all in a most interesting style. Numerous teaching aids are used such as "questions of fact," "questions of understanding," "experiments," "exercises and problems." Each chapter has review questions and a summary.

There are references and supplementary reading and suggestions of additional exercises for superior students. There is an appendix covering simple units of science and a useful glossary.
—W.G.W.

PATCH, EDITH M., AND FENTON, CARROLL L. *Desert Neighbors.* New York: The Macmillan Company, 1937. 170 p. $1.75.

It is interesting to know the kinds of living plants and animals that can endure the rigorous desert climate. Especially does one who travels need information of forms of life he may expect to see. This book gives one a good introduction to desert life. It shows that the desert is at all times a place of interest to the nature lover. The book is well illustrated by drawings.
—W.G.W.

LEYSON, BURR. *American Wings.* New York: E. P. Dutton and Company, 1938. 215 p. $2.00.

This is an interesting survey of the progress of aviation and a prediction of the flying of the future. Much of the material is presented from the military point of view, although there is considerable treatment of commercial and sports flying. Illustrations are photographs from the U. S. Army Air Corps.

There is a tendency to overemphasize the glamour of flying and to encourage the youthful reader to hero worship of the aviator.

One chapter offers guidance material in the form of advice concerning careers in aviation.

The book is readable, timely and engaging. Few will lay it aside without finishing it. In high schools, it is recommended as supplementary reading for boys in science and social studies classes.
—R.K.W.

HALL, CHARLES GILBERT. *Skyways.* New York: The Macmillan Company, 1938. 141 p. $1.32.

This is a simple history of aviation from the time of Daedalus in ancient Greece down to modern commercial aviation as typified by the *China Clipper.*

Illustrations are especially well done. These include pictures of early balloons, Langley's aerodrome, ancient kites and parachutes, the first plane of the Wright brothers, early airships, military planes, modern transport planes, and gliders.

The book is suited to the needs and abilities of pupils in grades five to eight. It is recommended as an addition to the libraries of elementary schools, or junior high schools. —R.K.W.

HALL, CHARLES GILBERT. *The Mail Comes Through.* New York: The Macmillan Company, 1938. 135 p. $1.32.

Source material for integrated units for pupils in the upper grades is not always easy to find. This volume is a history of the development of mail service from Old Testament Jewish times down to the airmail of today.

There are chapters on Roman roads and postal service, the London Penny Post, the postrider, the pony express, the airmail, and the dead letter office.

Social consequences—the building of roads, the effects upon the common interests of people, and the development of business—are woven into the narrative.

This book is recommended for pupils in grades five to eight. —R.K.W.

WOODRUFF, L. L. *Animal Biology.* New York: The Macmillan Company, 1938. 535 p. $3.75.

This is a second edition of a popular college text intended for college students in general zoology. The particular modification as compared with the earlier edition is the addition of a chapter on "The Human Background." This is essentially a brief treatment of human evolution, but also includes a brief history of prehistoric man.

As an introductory text this book deals with biological principles or concepts rather than with the details of technical classification of animal life. The material on classification is introduced early in the form of surveys of the larger classes of animals. The details of structure of higher animals are introduced toward the end of the survey of the vertebrates.

Throughout the emphasis is upon essential concepts rather than upon technical detail.

There are useful chapters on biology and human welfare and on the development of biology as a science.

The Appendix contains a brief classification of animals, reading lists grouped by chapters of the text, and a glossary of biological terms.

The book is recommended to teachers of introductory courses in general zoology for consideration as a text, and to high school teachers of biology as a useful reference. High school pupils in biology can read many of the chapters.
—R.K.W.

International Encyclopedia of Unified Science, Vol. I, No. 1. Chicago: The University of Chicago Press, 1938. 75 p. $1.00.

This first number contains contributions by Otto Neurath, Niels Bohr, John Dewey, Bertrand Russel, Rudolph Carnap and Charles W. Morris. Neurath says, "This encyclopedia continues the work of the famous French Encyclopédie." "To further all kinds of scientific synthesis is one of the most important purposes of the unity of science movement." "This movement has found in the International Congress for the Unity of Science—held yearly—its organized contemporary expression." The movement "includes scientists and persons interested in science who are conscious of the importance of a universal scientific attitude." Quoting from the announcement (inside back cover), the encyclopedia is the work of collaborators who "agree in considering the unity of science as the ideal aim of their efforts, in eliminating any form of speculation other than that recognized in science, in stressing the im-

portance of logical analysis in various fields and in taking into account the historical development of scientific concepts and regulative principles." To quote Neurath again "Empirical work of scientists was often antagonistic to the logical constructions of a priori rationalism bred by philosophico-religious systems . . . the two have now become synthesized for the first time in history."

Thus begins a very great and very important enterprise. The contents of this first number are, in the order of their authors as named above, Unified Science as Encyclopedic Integration, Analysis and Synthesis in Science, Unity of Science as a Social Problem, On the Importance of Logical Form, Logical Foundations of the Unity of Science, Scientific Empiricism. Space forbids attempting even a brief digest. Here is just a sample from Dewey's contribution. "The scientific attitude . . . on its negative side . . . is freedom from control by routine, prejudice, dogma, unexamined tradition, sheer self interest. Positively, it is the will to inquire, to examine, to discriminate, to draw conclusions only on the basis of evidence after taking pains to gather all available evidence. It is the intention to reach beliefs, and to test those that are entertained, on the basis of observed fact, recognizing also that facts are without meaning save as they point to ideas. It is, in turn, the experimental attitude which recognizes that while ideas are necessary to deal with facts, yet they are working hypotheses to be tested by the consequences they produce."

There are to be ten numbers in each of volumes one and two.

MORRIS, CHARLES W. Foundations of the Theory of Signs. Vol. I, No. 2, of the above encyclopedia. p. 59. 1938. $1.00.

"Signs" include all those means by which knowledge is transmitted from person to person. Science is expressed in signs. It is therefore eminently desirable that the use of signs be reduced to a science. "Semiotic holds a unique place among the sciences. . . . The scientist must be as careful with his linguistic tools as he is in the designing of apparatus or in the making of observations. . . . Semiotic is not merely a science among sciences but an organ or instrument of all the sciences."

This does not attempt to present the science of signs but merely to give some notion of its scope and importance. —E.R.D.

The Carnegie Foundation for the Advancement of Teaching. *The Student and His Knowledge.* New York: The Foundation, 1938.

This is a report on the results of comprehensive examinations given at high school and college level in Pennsylvania in 1928, 1930 and 1932. "It has employed new-type objective testing on a fairly large scale. In it more than 55,000 individuals have been tested thoroughly, nearly 3,000 more than once by the same tests."

"The initial purpose of the Pennsylvania inquiry was to reconsider our system of schooling in the light of obtained results viewed objectively on their merits." "We have also the record of 3,720 college seniors. Although the average score of the college seniors is much higher than that of the sophomores, 28.4 per cent of the seniors do less well than the average sophomore, and nearly ten per cent do less well than the average high school senior."

In a certain typical college it was found that if graduation were based on the results of the comprehensive tests only 28 per cent of the senior class that actually graduated would have done so while 21 per cent of the junior class, 19 per cent of the sophomores and 15 per cent of the freshmen would also have been in the senior class.

The gain made in a two-year interval when the students were given the same tests a second time was greater the younger the pupils. The gain made by those preparing to teach was less than that made by students preparing to enter other professions. There are valuable suggestions for the school administrator also. The report should shatter any smug complacency that exists regarding the great superiority of our schools in these United States. Fortunately it will do more; it will point the way to needed reforms. —E.R.D.

HJORT, JOHAN. *The Human Value of Biology.* Cambridge: Harvard University Press, 1938. 241 p. $2.50.

The lectures here presented were given first at the University of Oslo, Norway and, after revision, at Harvard University. They deal with the development of biological philosophy in its relation to general philosophy, then with problems of population. Many years of research in connection with Norwegian fisheries, in which field Dr. Hjort has been a directing expert, has familiarized him with population problems in the sea. His findings, here in part presented, are very instructive. Finally, he applies what he has learned to certain problems of human population with rare insight. It is good to find a book that ends with a note of optimism. "Scientific methods of thought and work which once were the monopoly of a small part of society are now spreading into all kinds of human activity. Men no longer work with objects of which they know nothing. The instruments of observation and thought and the knowledge which science can offer to assist their work are placed at the disposal of workers in an ever increasing degree. From this, freedom and happiness will follow. Life itself is consciously approaching the ideal of an optimum population." —E.R.D.

BENNETT, H. *The Cosmetic Formulary.* New York: The Chemical Publishing Company of New York, 1937. 279 p. $3.75.

Secondary science courses are definitely tending toward the inclusion of more concrete, practical material—toward what some have termed

consumer science. In chemistry classes this means the inclusion of a unit on cosmetics. Thus *The Cosmetic Formulary* meets a real need, not only of manufacturers, but also of secondary chemistry classes. No chemical knowledge is assumed, and the reviewer will attest to the fact that high school students can readily prepare marketable cosmetics by the use of the formulas included. Contents include: bath preparations, creams, dentifrices, deodorants, hair preparations, lotions, soaps, rouge and lipstick, perfumes and toilet water, skin ointments, and so on. Each formula has been tried and tested by chemists and technical workers.

Mr. Bennett is the author of the well known and widely used *The Chemical Formulary, Practical Everyday Chemistry*, and *More for Your Money*. The reviewer strongly recommends this book as being a most valuable addition to the secondary science book shelf. —C.M.P.

GROSVENOR, GILBERT, AND WETMORE, ALEXANDER. *The Book of Birds. Volumes I and II.* Washington, D. C.: National Geographic Society, 1937. 356 p., 374 p. $5.00.

These two volumes of the National Geographic Society comprise the first complete work ever published which portray with comprehensive detail and illustrations in full color all the major species of birds of the United States and Canada.

In the 738 pages of the two volume set there are 204 pages of full color plates showing 950 birds painted by the distinguished artist-naturalist Major Allen Brooks. There are 228 monochrome photographs depicting various aspects of bird life. There are 17 maps showing the remarkable new developments in the study of bird migration through bird banding. Accompanying the pictures are biographies that set forth the identifying characteristices of each species of bird, its range, breeding habits, and other features of behavior. There are 633 species described.

The material comprising these two volumes have appeared in *The National Geographic Magazine* over a period of years and most of of these articles have been abstracted in *Science Education*. The volumes are being sold at cost as The Society is non-profit making. Every high school library should place these volumes on the science shelf and they are recommended to biology, general science and elementary science teachers as the very best books that have been published on birds. —C.M.P.

BAILEY, BERNADINE, AND SELOVER, ZABETH. *Cave, Castle and Cottage.* Chicago: Follett Publishing Company, 1937. 96 p. $1.13.

The homes that people live in are as varied as the people themselves. Homes of men changed as man rose from savagery. This book intended for the upper intermediate or junior high school level tells something about the homes of early and modern men, and something about the peoples who have lived or are now living in these homes.

Long ago peoples lived in caves, and a little later some lived in homes built over lakes (the lake dwellers). In tropical lands some people construct houses of grass; others build homes in trees. Desert people usually live in tents. During the Middle Ages wealthy men lived in great castles made of stone. Many people, especially in China, live in house boats on the river. Indians live in wigwams and eskimos often live in houses made of ice. And today many Americans live in houses on wheels. The furnishings of many of these homes are described as well as the customs of the peoples. Excellent illustrations add to the attractiveness of the book.

—C.M.P.

DURAND, LOYAL, JR., AND WHITAKER, JOE RUSSELL. *Workbook for The Working World.* New York: American Book Company, 1938. 234 p. $0.56.

This workbook for Whitbeck, Durand and Whitaker's *The Working World* is primarily a completion or fill-in blank type. The exercises are integrated with the questions and problems found in the text. Unit tests accompany the workbook. —C.M.P.

JOHNSON, GAYLORD. *The Story of Earthquakes and Volcanoes.* New York: Julian Messner, Inc., 1938. 144 p. $2.00.

To readers of *Popular Science Monthly* the fact that Mr. Johnson is author of this book is sufficient reason for recommending it. His many readers in *Popular Science Monthly* will appreciate this latest addition to supplementary reading for secondary pupils. This work is probably the most simple, complete treatise that we have on earthquakes and volcanoes. Even an understanding of isostacy as a cause of earthquakes is made simple and understandable, although Mr. Johnson doesn't introduce that term! When it comes to lucid explanations, few authors can compare with him. The black-and-white illustrations, and photographs are particularly pertinent.

—C.M.P.

SMITH, DAVID EUGENE. *The Wonderful Wonders of One-Two-Three.* New York: McFarlane, Warde, McFarlane, Inc., 1937. 148 p. $1.00.

This enchanting book of the wonders of one, two, three will delight teachers and other readers as well as the children for whom it is written. This is an excellent supplementary book for arousing interest in arithmetic—a field so difficult to popularize. Adults will enjoy many of the "magic" tricks that may be performed with numbers.

The author is one of our best known mathematicians. The illustrations by Barbara Ivins add much to the attractiveness of the book.

—C.M.P.

MCFARLAND, J. HORACE. *Roses of the World in Color.* Boston: Houghton Mifflin Company, 1936. 296 p. $3.75.

The rose has been called the queen of the flowers. And anyone who examines this book,

likely, will be convinced if he is not already of that opinion. There are more than 275 color plates, the result of many years of experience with Lumiere autochrome photography. The color plates are described as reasonably accurate. There are also numerous pictures in black and white.

The author is an authority on roses, and editor of the American Rose Annual. In his world-famous Breeze Hill Gardens in Boston are found all of the outstanding roses of the world.

This is not a mere picture book although it could easily justify itself on this basis alone. There is a brief history of roses, excellent suggestions for selecting, planting and caring for roses and brief descriptions of each rose pictured. The roses are classified as to kinds and also indexed alphabetically.

To every lover of beauty, to the home owner, and to the biology teacher this book is highly recommended. Here is a chance for the biology teacher to bring beauty to the attention of his biology students—and by chance a pupil will want to plant some roses in his own front or back yard! A suggestion is often enough!

—C.M.P.

LATHROP, DOROTHY P. *Animals of the Bible.* New York: Frederick A. Stokes Company, 1937. 69 p. $2.00.

This is a picture book of the animals of the Bible illustrated with excellent black-and-white drawings. The drawings are accompanied by suitable textual material taken from the King James version. There are double page drawings of the Creation, Noah's Ark and Isaiah's Peaceable Kingdom, and full page drawings of Eve's serpent, Abraham's ram, Daniel's lions, Jonah's whale, the Good Samaritan's beast, the Prodigal Son's pigs, Isaac's camels at Rebekah's well and many others. —C.M.P.

QUINN, VERNON. *Leaves, Their Place in Life and Legend.* New York: Frederick A. Stokes Company, 1937. 211 p. $2.00.

This unique and appealing book, interwoven with lore and legend, with quaint folk-beliefs and superstitions, with curious and little known facts, contains a vast amount of authentic information about leaves. There are chapters on the following: (1) the shapes and habits of leaves, (2) curious leaves, (3) poisonous leaves, (4) fragrant leaves, (5) stimulant leaves, (6) edible leaves, (7) strange use of leaves, and (8) leaves and superstitions.

Leaves have been and still are used for sundry purposes. Two excerpts regarding leaves follow:

"Certaine report that the dayly eating of the Cresses (watercress) for a time purchaseth a readier understanding and quicker wit . . . the iuice dropped into the ears doth remove the grievous paine of the teeth. It availeth against the Measells if the same mixt with honey be applyed with linnen clothes dipped in it—this removeth the red spots."

"The iuyce of ye Onyon annoynted on a bald place recovereth the haires shed. There be which affirme that the green onyon applied with vinegar doth helpe the bite of a madde dog within three dayes."

This book will afford interesting reading for the general lover of nature, the secondary biology pupil and biology and elementary science teachers.

—C.M.P.

WEBSTER, HANSON HART, AND POLKINGHORN, ADA R. *What the World Eats.* Boston: Houghton Mifflin Company, 1938. 380 p. $2.00.

This is an excellent supplementary reader for the intermediate grades. The story of the foods eaten by man the world over is always interesting and intriguing. The delectible style and apt illustrations make this an exceptionally valuable addition to the library shelf. How queer do some of the foods other peoples eat, that we do not eat, seem to us. Many of our foods would likely seem as queer to them. The human race is in many respects a queer one, and in no other activity does it show greater variances than in the foods consumed.

The major topics considered are: (1) our favorite fruits, (2) vegetables at home and in other lands, (3) cereals and breads, (4) foods we get from animals, and (6) other foods.

—C.M.P.

MILLER, GEORGE J. (Editor). *Activities Geography.* Bloomington, Illinois: McKnight and McKnight, 1937. 87 p. $0.96.

This is a collection of material for student activities—games, puzzles, pageants, assembly programs, and so on. This book should meet a long-felt need as there is always great demand from classroom teachers for such material. Part I is devoted to 25 games and puzzles; Part II has 15 articles on projects, exhibits and displays; Part III has 23 exercises, drills, and reviews; and Part IV has 9 plays, programs and pageants.

—C.M.P.

YATES, RAYMOND F. *How To Make Electric Toys.* New York: D. Appleton-Century Company, 1937. 199 p. $2.00.

This is an experiment book for the amateur in electricity. Simple experiments are described and the beginner "will have no trouble performing the experiments and making the toys and gadgets described in this book." All materials needed are inexpensive and "none of the experiments are dangerous." Many experiments are illustrated.

Among the many experiments described are: (1) an electric bug exterminator, (2) radio set on a pencil, (3) an electric air-rifle target, (4) fun with dots and dashes, (5) an electric alarm, (6) a loud-speaker for your room, (7) how to transmit pictures from one room to another, (8) paper dolls that dance by radio, (9) electric gong, (10) the shocking coil, (11) the electric genie, and (12) how to do electro-plating.

The book is suitable for the general science or physics student and for general science and elementary science teachers. —C.M.P.

VERRILL, A. HYATT, AND BARRETT, OTIS W. *Foods America Gave the World.* Boston: L. C. Page and Company, 1937. 289 p. $3.00.

A surprisingly large number of our foods are distinctly American in origin and were unknown to the civilized world before the discovery of America. The world's diet was greatly changed by the voyage of Columbus. The most primitive tribes of Indians as well as the Aztecs, Mayas and Incas, had their gardens and cultivated fields.

Among the foods America gave the world are: (1) corn, (2) tomatoes, (3) pumpkins and squashes, (4) potatoes, (5) chili peppers, (6) sweet potatoes and yams, (7) tapioca and cacao, (8) chocolate, (9) peanuts, (10) Jerusalem artichoke, (11) pineapples, (12) strawberries, (13) blueberries and huckleberries, (14) choke cherry, (15) wildgoose plum, (16) blackberries, (17) raspberries, (18) vanilla bean, (19) papaya, (20) sapodilla, (21) mamey, (22) anona, (23) guava, (24) star apple, (25) sikona, (26) cashew, (27) avocado, (28) chestnut, (29) hickory nut, (30) pecan, (31) black walnut, (32) butternut, (33) hazel nut, (34) wild filbert, (35) brazil nut, (36) beech nut, (37) souri nuts, (38) paradise nuts, (39) turkey, and many more.

Interesting lists of history and information are given about each of the various foods. A useful appendix is included, giving the common English, Spanish or West Indian names of the plant as well as the native Indian names when known, and the Latin names.

This is a useful reference book for the biology and elementary science teacher and for the high school book shelf. —C.M.P.

MERRILL, FREDERICK T. *Marihuana.* Washington, D. C.: Opium Research Committee of Foreign Policy Association, 1938. 48 p. $0.15.

Within the last few years grave concern has been aroused at the alarming spread of marihuana and its increasing use by youth. Its use is confined chiefly to smoking in the form of cigarettes. Ease of growth greatly adds to the difficulties of eradication. Effects on persons using it are unpredictable. This booklet describes the plant, its abuses, forms in which used, effects of use, and efforts at control. —C.M.P.

ATWOOD, WALLACE W., AND THOMAS, HELEN GOSS. *The Growth of Nations.* Boston: Ginn and Company, 1936. 388 p. $1.80.

This book could be used either as a textbook or as a supplementary reader for the upper elementary grades. As stated in the preface:

"In *The Growth of Nations* enough time has been spent in considering the past to enable pupils to understand the present. They are shown how during the course of many centuries the people in various parts of the world grouped themselves together to form what we call nations, and how some of these nations enjoyed but a short existence, whereas others which long ago rose to power and prominence still exist but have lost their positions of leadership, and still others—a mere handful of the sixty-odd nations of the present time—have become great powers."

The first part of the book treats briefly of the strong nations of ancient times with reasons for their growth or downfall. The remainder of the book is a study of the leading nations of today.

The book is attractive in format and style, with approximately 400 pictures and illustrations. These greatly add to the appeal of the book. —C.M.P.

SUTTON, RICHARD MANLIFFE. *Demonstration Experiments in Physics.* New York: McGraw Hill Book Company, 1938. 545 p. $4.50.

This is a collection of nearly 1200 lecture experiments for the use of high school and college teachers of physics and general science. There are 328 experiments in mechanics, 153 in sound, 182 in heat, 269 in magnetism and electricity, 136 in light, and 121 in atomic and electronic physics. The book was prepared under the auspices of the American Association of Physics Teachers. The experiments represent contributions from 200 physicists in 130 institutions. Descriptions of experiments are simple and direct, often illustrated. As a whole, and this is to be expected in light of the great number, most of the experiments are more applicable to college science than to secondary science. Yet there is a sufficient number of the latter to make this book a most valuable aid to high school science teachers. This book will be an invaluable aid to college teachers of physics and general science. —C.M.P.

MACLEOD, ANNIE LOUISE, AND NASON, EDITH H. *Chemistry and Cookery.* New York: McGraw Hill Book Company, 1937. 568 p. $3.50.

This is a textbook intended for students of general chemistry whose major field is home economics. The book retains the essential fundamentals found in any general chemistry textbook, but radically departs from the ordinary text in the illustrations and applications used. And this is exactly as it should be. It is the opinion of the reviewer that this book is far better adapted to the needs, interests and previous experiences of women students in freshman chemistry than any textbook he has examined. It is unhesitatingly recommended for all women students of chemistry, unless it would be those majoring in chemistry and the reviewer isn't so sure but that even majors would find it much better than the usual textbook. The general style, language and vocabulary employed should make it a most teachable book.

Some of the chapters not found in many general chemistry textbooks are: (1) oils and fats, (2) soaps and the cleansing properties, (3) flour and other grain products, (4) eggs and egg cookery, (5) meat and meat cookery, (6) vegetable cookery, (7) colors in vegetables and their

changes during cookery processes, (8) milk and milk products, (9) beverages, (10) food preservation, and (11) concerning batter and doughs.

A list of laboratory experiments to accompany the text are included in the back part of the book. It would seem that some improvement might be made in these, especially as to development and organization. —C.M.P.

BARTON, WILLIAM H., AND JOSEPH, JOSEPH MARON. *Starcraft.* New York: Whittlesey House (McGraw Hill Book Company), 1938. 228 p. $2.50.

Starcraft is an unusually good book for the amateur astronomer interested in naked-eye observation. Very few hobbies are as interesting and enjoyable as that of star observation. To the many now having astronomy as a hobby, would be added many others, especially teachers, if they felt that they could learn to know the stars and constellations through their own efforts. The reviewer believes that amateur astronomy is one of the easiest of hobbies to cultivate. The sky is the laboratory, and there are numerous guides that make observation relatively easy. Starcraft is one of the very best guides that beginners will find. Elementary science, general science teachers and beginners in star observation will find this a most usable guide. The last hundred pages are devoted to detailed guide for making simple and easily constructed devices for studying the heavens. —C.M.P.

ROSEVEAR, FRANCIS BURR. *Science Craft Mineralogy Manual.* Hagerstown, Md.: The Porter Chemical Company, 1936. 148 p.

This is a rather complete compact manual of pocket size. Elementary and general science teachers, and others interested in knowing and identifying rocks and minerals will find this a most useful guide. Chapter I treats of the geology of the three major classes of rocks; Chapter II discusses the chemical reactions involved; Chapter III is on crystallography; Chapter IV—physical properties; Chapter V—blowpipe and chemical tests; Chapter VI is descriptive of the various kinds of rocks and minerals; Chapter VII tells about gems; Chapter VIII tells how to make a collection; Chapter IX is on the determination of rocks and minerals. A total of 133 experiments is included. —C.M.P.

PORTER, HAROLD M., AND PORTER, JERMAIN D. *Chemcraft Experiment Book: Directions for Performing 814 Experiments.* Hagerstown, Md.: The Porter Chemical Company, 1937. 237 p. $1.50.

This Chemcraft laboratory manual gives directions for performing many of the usual beginning chemistry experiments and in addition numerous ones seldom or rarely found. These latter relate more to such experiments as those on dyes, glass, paint, varnishes, perfumes, flavors, leather, textiles, photography, soap, foods, electro-chemistry, metallurgy, and chemical magic.

This is a highly recommended book for the science bookshelf, for the science club, and for the personal library of chemistry, general science and elementary science teachers. —C.M.P.

PORTER, HAROLD M. *Chemistry of Foods and Household Materials.* Hagerstown, Md.: The Porter Chemical Company, 1937. 107 p.

The 337 experiments described in this book relate to the following fields: (1) digestion of food, (2) the classification and composition of foods, (3) proteins, (4) fats, (5) water, (6) mineral elements, (7) canning and preserving, (8) condiments, (9) laxatives, (10) antiseptics, (11) anesthetics, (12) textiles and dyes, (13) soaps and cleaners, (14) stains, (15) bleaching, (16) cosmetics.

Science club sponsors, science students, and general science, chemistry and elementary science teachers will find this one of the most useful little booklets on science experiments they have ever chanced upon. —C.M.P.

PORTER, JERMAIN D. *Chemcraft Rubber Chemistry Manual.* Hagerstown, Md.: The Porter Chemical Company. 77 p.

This is a combined text and laboratory manual on rubber and its chemistry. Chapter headings are as follows: (1) the world discovers rubber, (2) how we get our rubber, (3) what rubber is and how it is used, (4) making tires, (5) wearing apparel, and (6) sulfur. There are 52 experiments listed. To the average chemistry teacher it is here that the real value of the booklet lies. So often the teacher would like to have access to information on experiments with rubber. This booklet is an answer to the problem. —C.M.P.

HETHERSHAW, LILLIAN. *A Guide for Teaching Science in Grades One to Eight.* Des Moines, Iowa: Department of Public Instruction, 1937. 109 p.

This elementary science guide develops teaching procedures for teaching 28 units in elementary science—11 in the primary grades and 17 in the intermediate and upper grades. The primary units are as follows: (1) signs of fall, (2) farm animals, (3) Christmas trees and greens, (4) animals of the circus and zoo, (5) feeding birds in winter, (6) the story of ants, (7) the uses of magnets, (8) pets and their care, (9) some animals of the pond and stream, (10) the aquarium, and (11) conservation of wild flowers.

The intermediate grade units are: (1) how seeds are scattered, (2) some insects which help us, (3) how some fur-bearing animals protect themselves, (4) rocks and minerals in everyday life, (5) homes and home life of birds, (6) trees and their uses, (7) how some fur-bearing animals live in winter, (8) the travel of birds, (9) value of insects to man, (10) electricity and its uses, (11) conservation, (12) our earth and its neighbors, (13) water and its uses, (14) the air, (15) the weather, (16) the changing surface of the earth, and (17) some plants harmful to farm crops.

Each unit has the following divisions: (1) outline of procedure, (2) some things for pupils to do, (3) outline of the unit, (4) important points to be developed, (5) for the enrichment of the pupil, (6) books for the teacher, and (7) books for pupils. A general bibliography is included at the close of the book. —C.M.P.

FRASIER, GEORGE WILLARD, DOLMAN, HELEN, AND VAN NOY, KATHRYNE. The Scientific Living Series. *We See*. 1937. 32 p. $0.20; *Sunshine and Rain*. 1937. 64 p. $0.60; *Through the Year*. 1937. 160 p. $0.72; *Winter Comes and Goes*. 1938. 224 p. $0.84; *The Seasons Pass*. 1938. 288 p. $0.96. Syracuse, New York: The L. W. Singer Company.

The above books of the Scientific Living Series are intended as Pre-Primer, Primer, First Grade, Second Grade and Third Grade books. Based on recent courses of study and the recommendations of the Thirty-First Yearbook of the National Society for the Study of Education, the books are wide in scope, including materials from all fields of science with a special emphasis on health.

The books consciously make an attempt to teach science concepts as much by illustration as by the printed word. Consequently the books are superbly and effectively illustrated in color reproduced from original water color paintings. The method used is known as the 4-Color Deeptone Process. From the standpoint of mechanical make-up, washable, ink-proof, water-proof, vermin-proof covers, and non-glare paper—the books are unsurpassed. Also the content has been as carefully selected, both as to the concepts developed and the vocabulary employed. The series together constitute an integrated series of readers that will add much prestige to supplementary reading material in elementary science. The ultimate test of the excellence of this material will be "Do the children like it?" and the reviewer believes they will emphatically answer "yes."

—C.M.P.

SYMPOSIUM. *Science in General Education*. New York: D. Appleton-Century Company, 1938. 591 p. $3.00.

This is a report of the Committee on the Function of Science in General Education, Commission on Secondary School Curriculum, Progressive Education Association. This is one of a series of publications of the Commission; Part I discusses science teaching in relation to general education. Part II—teaching science to meet the needs of adolescents in the basic aspects of living. Part III—understanding the student and evaluating his growth; and Part IV—using the report as a basis for planning the science program. The appendix contains four illustrative units as follows: (1) a course in functional chemistry, (2) a fused physical-science course, (3) unit on public health, and (4) a course in genetics.

Undoubtedly, this is the most significant publication on science teaching since the publication of the 31st yearbook of the National Society for the Study of Education. That it will greatly influence future science teaching is quite evident, for it makes a keen analysis of present trends in outstanding progressive schools. That the methods, techniques, and means of evaluation described in this book will soon become woof and warp of most American science programs is an idle dream—we make progress but slowly. If there were some way of compelling every science teacher to read this report and think through its implications—we might make a fairly rapid progress toward the goals set up in this treatise. But alas—years will elapse before a majority of science teachers and school administrators ever hear of the report—let alone read it. —C.M.P.

THE JOINT COMMITTEE ON CURRICULUM. *The Changing Curriculum*. New York: D. Appleton-Century Company, 1937. 351 p. $2.00.

This book is an integrated compilation of thirteen chapters written by the ten members of the joint committee of the Department of Supervisors and Directors of Instruction and the Society for Curriculum Study. For this reason it is particularly worth while and stimulating. It includes excellent discussions on present curriculum status, philosophical aspects of curriculum formulation, function, organization, planning for curriculum development, organization of machinery for curriculum development, units of learning experience, evaluation of curricula, analyses of curriculum innovations, and teacher preparation for the new curriculum.

The committee seems agreed on the desirability of more emphasis upon experience units as basic in the curriculum of the future and the application of the principles of organismic psychology in curriculum practice. Stress is placed on continuous investigation and experimentation as the only procedure which will eventuate in improvement of the curriculum. —A.W.H.

MILLER, DAVID F. and BLAYDES, GLENN W. *Methods and Materials for Teaching Biological Sciences*. New York: McGraw-Hill Book Company, Inc., 1938. 434 p. $3.00.

For a long period of time science teachers were almost without new books on the teaching of science. In the last five years there has been a revival of interest in books on the teaching of science. The last few have been on the teaching of biology. The new book reviewed here is the latest of these.

This book is divided into two parts. The first part is intended to serve as a text for courses dealing with special methods in teaching biological sciences. The second part consists of a manual of practices and of source materials. It is intended to furnish very practical helps for the teacher who works with very limited equipment or who has had limited experience in setting up demonstrations and experiments.

Chapters of the first division deal with objectives, types of biology courses, methods of presentation, planning teaching, evaluation, visual

education, choosing textbooks, and trends in the curriculum. Chapters in part two deal with collection and preservation of specimens, laboratory aids and substitutes, and preparing materials for the microscope. Other chapters in this section deal with special preparations for each of the major divisions of biology, e.g. respiration, response, reproduction, heredity, et al.

The avowed purpose of the authors is "to encourage the teachers of biological subjects to abandon the all too common practice of teaching from the textbook, with little use of materials:" Possibly the authors have overlooked the fact that few secondary school science teachers teach only biology. The remedy for overemphasis on textbook teaching does not lie wholly in lack of information about materials. Pupil loads, administrative duties of teachers, and participation in extracurricular programs are also factors in the encouragement of textbook teaching with little use of materials.

The book will find a place as a text in special methods courses in the teaching of biology in schools of education and teachers colleges. The addition of part two will make it a valuable addition to the permanent library of every high school biology teacher. —R.K.W.

NATIONAL EDUCATION ASSOCIATION. *1937 Proceedings of Department of Science Instruction.* Lincoln, Nebraska: Harold E. Wise, University of Nebraska, Teachers College, 1937. 144 p. $0.50.

This bulletin contains the addresses made at the department of science instruction section meetings of the 1937 National Education Association meeting held at Detroit, Michigan. The addresses by title and author are: (1) "Shall the Desirable Objectives Be the Basis for the Selection of Subject Matter?" by Francis D. Curtis, (2) "The Subject Matter of Science Should Determine Objectives" by Carleton E. Preston, (3) "Avoiding the Unpsychological Unit in the Organization of Science Subject Matter" by George Skewes, (4) "How Teachers May Improve in Service" by J. A. Hollinger, (5) "A Purposeful Program for In-service Teacher Training" by George W. Fowler, (6) "How Teachers May Improve in Service" by Bertha M. Parker, (7) "The Cooperative Teacher Improvement Program in California" by Lesley C. Walker, (8) "Methods for the Improvement of Elementary Science Teachers" by Theodosia Hadley, (9) "Some Essential Factors to Be Considered in Developing an Elementary Science Course of Study" by Mary Melrose, (10) "Soil Conservation Teaching in Schools" by Helen M. Strong, (11) "A Method of Organizing a Unit in Elementary Science" by Margaret L. Wilt, (12) "Air" by Alma M. Jolson, (13 "Spring—a Season" by Mary L. Garvey, (14) "Air and Fire—Second Grade" by Lillian C. Compton, (15) "The Indianapolis Junior High-School Course of Study in General Science" by Virgil Stinebaugh, (16) "Shall We Have a Continuous Program in Science for the Junior-High School" by Clarence E. Evaul, (17) "Providing for Individual Differences through the Contract Plan of Organization" by Dorothy F. Osborn, (18) "Effect of Instruction on Superstitious Beliefs" by Rosalind M. Zapf, (19) "The Science Program of the Junior-High Schools of Springfield, Missouri" by Elizabeth F. Cadle, (20) "A Basis for Revising the Science Program in the Junior-High Schools" by W. D. Bracken, (21) "A Three Year Program in the Junior High Schools of Superior" by Iaan J. Cartright, (22) "The Improvement of Instruction through Classroom Research" by Robert L. Ebel, (23) "The Science Program in the Senior High Schools of Detroit" by Fred D. Leonhard, (24) "A Course in Biology for the Modern High School" by Paul Visscher, (25) "Reorganization of Science in the Senior High School" by Louis J. Mathias, Jr., (26) "A Science Course for the Non-College Students" by Freda Parmalee, (27) "Teacher Improvement through a State Cooperative Testing Program" by George Peterson, (28) "A High School Science Curriculum which Meets the Needs of Pupils" by Norris Bush, (29) "Experiences with a Continuous Science Program" by George W. Blount, (3) "Vitalizing Science Instruction" by K. C. Johnson, (31) "A Method for Providing for Retarded Pupils in General Science" by Erwin M. Johnson, (32) "Reptile Pets" by Laverne Argabright, and (33) "Specific Illustrations of the Reorganization of Subject Matter in Chemistry in the Senior High School" by H. Leslie Ferguson. —C.M.P.

BODE, BOYD H. *Progressive Education at the Crossroads.* New York: Newson and Company, 1938. 128 p. $1.00.

Dr. Bode attempts in this little book to outline the path which progressive education may follow in justifying its existence. In successive chapters he discusses the relation of progressive education to democracy, the doctrine of interest, the concept of needs, education as growth, teaching the child and the subject, and social education.

His thesis seems to be that the concept of progressive education is identical with certain concepts of democracy. Democracy is a way of life and progressive education may realize its purpose through definite direction of effort toward helping the common man to come into his own.

The discussion is not always clear probably because of the phraseology employed, but the issue itself is challenging. A.W.H.

BRYAN, ROY C. *Pupil Rating of Secondary School Teachers.* New York: Bureau of Publications, 1937. 96 p. $1.60.

This is a doctoral dissertation to determine: (1) how reliable and how valid are the pupil ratings of junior and senior high school teachers, (2) to determine how much agreement there is between the ratings of teachers by junior and senior high school pupils and administrators, (3)

to determine the effect such factors as the following have on pupil ratings: (a) pupil mental ability as determined by standardized intelligence tests, (b) marks received by the rater from the teacher rated, (c) sex of the pupils and teachers, and, (4) to discover what items have most weight in determining general teaching ability.

Data were obtained from a Brooklyn junior high school having an enrollment of 3000 and a staff of 94 teachers, and a senior high school of 800 pupils and a teaching staff of 30 teachers, located near Cincinnati. The data show that pupil ratings on most items were highly reliable. Pupil marks have some effect on pupil ratings. Girls tend to rate women teachers higher than boys do, and boys tend to rate men teachers higher than girls do. The items that had most weight with the pupils of this study in determining general teaching ability are: (1) amount pupils are learning, (2) ability to explain things clearly, (3) teacher's knowledge of subject, and (4) amount of work done by teacher. Pupil liking for teacher and sympathy were two other items ranking high.

The data received sound statistical treatment and the study seems to be considerably above the average in worthwhileness. —C.M.P.

BEAUCHAMP, WILBUR L., MAYFIELD, JOHN C., and WEST, JOE YOUNG. *Science Problems for the Junior High School.* Chicago: Scott, Foresman and Company, 1938. 432 p. $1.28.

This is volume one of a new junior high school science series. There are eleven units, each divided into a number of "problems." The selection of units follows that which has become familiar as the pattern for existing general science texts.

The formula upon which each unit is built consists of a preliminary photograph, a set of introductory exercises, a unit introduction, or preview, the development of the problems of the unit, a set of self-testing exercises for each problem, for some units, a group of problems to solve, a collection of summary exercises, and sometimes suggested additional exercises.

The general scheme follows the senior author's interpretation of the Morrisonian technique as developed at the University of Chicago. This proposed learning sequence is outlined for pupils in a preface addressed to the pupils and not to the teacher. Pedagogical devices are written directly into the text as an integral part of the whole sequence.

The learning of the pupil depends largely on a whole series of simple laboratory exercises. Most of these can be done without complex apparatus; many can be carried out at home. In general the learning scheme does not depend upon a great amount of reading on the part of the pupil. Directions for work are clear and easily followed.

Mechanically, the book is attractive. Illustrations are clear and well done.

All teachers of junior high school science will be interested in examining this text. Each teacher should consider the feasibility, for his own teaching conditions and his own educational philosophy, of the teaching procedure about which this book is built. In considering the adoption of the whole series, it would be wise to examine the other two volumes along with this first one. The second and third volumes were not available for the reviewer.

The authors have without question produced a text that will be found attractive by many young people of beginning junior high school age.

—R.K.W.

BROMLEY, DOROTHY DUNBAR and BRITTEN, FLORENCE HAXTON. *Youth and Sex.* New York: Harper and Brothers, 1938. 303 p. $3.00.

This is a study of 1300 college students, representing 45 colleges and universities from all parts of the country. A detailed questionnaire and personal interviews were the techniques used. This book presents, synthesizes, and evaluates the information gained.

Sex education is receiving a great deal of serious attention from secondary school and college authorities. How this problem can best be handled is still a moot question. Failure of parents has presented school authorities with a problem whose solution has been ineffectively met thus far.

This book presents probably the most reliable information on the college level that is now available. Conditions in college may be indicative of conditions and problems in secondary schools, making this a valuable source of information for teachers of biology and health education in secondary schools. —C.M.P.

MALINOWSKI, BRONISLAU. *The Sexual Life of Savages.* New York: Halcyon House, 1938. 603 p. $1.89.

This is a reprint of a book first published in 1929, and selling for $10.00. This is a study of a primitive society. There is an introduction by Havelock Ellis. The following problems are considered: (1) relations between the sexes, (2) status of women, (3) avenues to marriage, (4) betrothal, (5) marriage, (6) polygamy, (7) divorce, (8) procreation, (9) pregnancy, (10) childbirth, (11) forms of license, (12) lovemaking, (13) erotic dreams, (14) morals and manners, and (15) the myth of incest.

—C.M.P.

CLARK, LEMON. *Emotional Adjustment in Marriage.* St. Louis: The C. V. Mosby Company, 1937. 261 p. $3.00.

The author considers the sexual side of life in its relation to the individual, the family, and society. Individual problems are considered. Many factors enter into emotional adjustment in marriage. Here the author considers only one factor—covering that thoroughly and practically.

Dr. Clark is now on the staff of the University of Illinois School of Medicine as Assistant in Obstetrics and Gynecology. —C.M.P.

VON EULENBURG-WIENER, RENEE. *Fearfully and Wonderfully Made.* New York: The Macmillan Company, 1938. 478 p. $3.50.

In this volume the author has presented in a semi-popular fashion, an interpretation of the human organism. It is written in an easily readable fashion. It is thorough and up-to-date.

It is recommended for supplementary reading for secondary schools and biological science courses in junior colleges.

Those without foundation might find difficulty in interpreting the chemical formulae with which the author has explained certain difficult chemical reactions and substances.

In general, the author has presented a story that will lead the reader deeper into the volume. —E. C. Harrah.

HOLME, C. G. *Modern Photography 1938–39.* New York: The Studio Publications, Inc., 1938. $3.50.

This is the eighth successive annual of the year's best prints. There are 110 reproductions, eight in full color and eight large, glossy plates in monochrome. This is not only the best in camera art, but the technical information showing the conditions under which each picture was taken, the camera and materials used, are valuable aid to amateurs and professionals who wish to improve their own technique.

In the opinion of the reviewer this annual is easily the best of the series that has yet appeared —probably the best annual of the numerous ones now appearing. Camera art has made great progress in the last few years and nowhere is this advance better portrayed than in this Studio annual. —C.M.P.

FRAPRIE, FRANK R., Editor. *The American Annual of Photography 1939.* Boston: American Photographic Publishing Company, 1938. 330 p. $1.50.

This is the fifty-third edition of a well known photographic yearbook. It contains a number of rather technical articles in addition to those of general interest, all of which are excellent. Approximately a hundred pictorial illustrations together with technical data and criticisms are included. Both the articles and the illustrations maintain the usual high standard of this publication. The article on filters is especially recommended.

This annual is recommended to all having more than a mere casual interest in photography. —P. E. Hatfield.

DUTTON, LAURENCE. *Perfect Print Control.* New York: The Galleon Press, 1937. 160 p. $2.50.

Both amateur and professional photographers will wecome this book on printing and enlarging. The parts relating to enlarging techniques are especially good as the material is profusely illustrated with pictorial examples, tables, graphs and working formulas. Methods of determining what printing and enlarging paper to use, what degree of contrast is best, what exposure, what tonal quality, are among the many practical suggestions given. Spotting, trimming and mounting, development, fixing, washing and drying prints and other topics are discussed. —C.M.P.

TAYLOR, G. HERBERT. *My Best Photographs and Why.* New York: The Dodge Publishing Company, 1937. 90 p. $3.00.

All who are interested in photography as a hobby or as a profession will be delighted with this book. They will find in it both inspiration and aid in their photographic efforts. The book is unique and easy to read. It brings together forty full page pictures, 8½ by 11¾ inches, made by as many different photographers all of whom are eminent in their particular fields. Each picture has been selected by its respective photographer as representing what he considers his best or most appealing picture. This means that forty different points of view are represented. Accompanying each picture is a discussion by the photographer in which he gives the name of the picture, the problems encountered in taking it, the treatment involved in securing the desired effects, a statement of why the particular picture was selected, and a brief résumé of the career of the photographer. In other words, the story behind each picture is told and not left to the imagination of the reader or implied in the title.

The reprints are on heavy paper bound in a cardboard cover by a spiral binding. The striking design on the cover was made by Harper Richards. —F.G.B.

FOWLES, G. *Lecture Experiments in Chemistry.* Philadelphia: P. Blakiston's Son and Company, Inc., 1937. 564 p. $5.00.

This is an English publication, but the experiments include many of those commonly used in America. There are a total of 547 experiments fairly comprehensive as to scope. The originator of the experiment when known is given credit. Directions for performing the experiment seem to be adequate. Illustrations are often used.

The last 56 pages of the treatise consider the aims and methods of teaching chemistry. Methods considered are: (1) the informative method, (2) the heuristic method, (3) the normal experimental method, (4) the historical method, and (5) the modern method (incorporating many chemical phenomena into generalizations and so eliminating as far as possible, inorganic and physical chemistry).

The reviewer knows of no better, cheaper way a chemistry teacher (especially in high school) could improve his teaching skill than by having access to, and using this book. —C.M.P.

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